

GRASSHOPPERS OF THE GENUS *KAROKIA* AND OF THE
SALTATOR, IMMUNIS, AND HARPERI SPECIES GROUPS
OF THE GENUS *MELANOPLUS* IN CALIFORNIA AND OREGON
(ORTHOPTERA: ACRIDIDAE)

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This issue mailed on August 5, 1968

GRASSHOPPERS OF THE GENUS KAROKIA AND OF THE
SALTATOR, IMMUNIS, AND HARPERI SPECIES GROUPS
OF THE GENUS MELANOPLUS IN CALIFORNIA AND OREGON
(ORTHOPTERA:ACRIDIDAE)

by

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In this paper we review the systematics, distribution, and related aspects of several groups of flightless grasshoppers inhabiting the West Coast of the United States. All belong to the subfamily Cyrtacanthacridinae, "spine-throated grasshoppers." Included subject matter is as follows:

1. A revision of the genus *Karokia*, formerly regarded as a subgenus of *Boonacris*. We consider this a distinct genus, which now includes 2 species, one of them described herein as new. They are known only from the Trinity Alps area of northern California. In this genus, the tegmina are entirely lacking; included is a key to the 7 genera of the supertribe Melanoplinae inhabiting the Pacific Coast States which lack tegmina.
2. A full review of the *saltator* group of *Melanoplus*, which extends from central Washington to southern California, with one Nevada record. There are 11 species, one of them described herein as new.
3. A review of the 13 species (including 3 new species) of the *immunis* group of *Melanoplus* in California and Oregon. Other species of the group inhabit Utah, Arizona, and New Mexico.
4. A discussion of variation found in *Melanoplus harperi* Gurney and Buxton, the only member of the *harperi* group of *Melanoplus*. This species is known only from the Trinity Alps.

Detailed examination of the male genitalia is important in the recognition of species of these genera and in the study of generic relationships. The basic technique of preparing male genitalia of *Melanoplus* was outlined by Gurney and Brooks (1959, p.5). Since then, however, we have realized the advantage of treating the genital complex moderately by caustic potash. Readers are referred to Gurney, Kramer, and Steyskal (1964) for the procedure of using caustic potash to clear non-sclerotized portions of the genitalia and for the use of microvials in storing preparations.^{1/}

Two previously overlooked structures of the male genital complex have been found useful in differentiating species in the *saltator* group of *Melanoplus*, so far as we know for the first time in the genus *Melanoplus*: one of them is the rami of the cingulum and the other is the shape and degree of sclerotization of the sclerite of the basal fold (membrane immediately posterior to the epiphallus).

^{1/}

Microvials currently available from: Arthropod Specialties Co., P.O. Box 1973, Sacramento, California 95809.

Much of the incentive for preparing this paper and some of the more interesting specimens here reported came from a collecting trip which we made in northern California in September 1964.^{2/} We spent 6 days at Grizzly Meadows, Trinity County, aided by A. G. Forbes (Bureau of Entomology, California Department of Agriculture), Richard M. Thompson (Plant Pest Control Division, A.R.S., U. S. Department of Agriculture), and W. J. Kamp (then of Shasta College, Redding, California). Later we made a hurried collecting trip through the Mt. Shasta area, the Warner Mountains, and the vicinity of Donner Pass. Gurney also collected briefly near Mendocino and at Plaskett Meadows with the assistance of Jacques R. Helfer.

Other acknowledgements are as follows: To the late Harold J. Grant (Academy of Natural Sciences of Philadelphia) and H. F. Strohecker (University of Miami, Florida) for the loan of specimens and cooperation in clarifying identifications; to T.R. Haig (California Department of Agriculture), J. W. Anderson and T. O. Peacock (Del Norte County Department of Agriculture, California), and L. M. Jensen (U. S. Department of Agriculture) for painstakingly collecting and providing several valuable series of specimens; to George W. Byers (University of Kansas) for assistance in clarifying a locality mentioned on a label, and to Mrs. Twila Freeman for typing the final manuscript and plotting of maps.

Figures 1-4, 7-25, 29, 33-34, and 37 were drawn by Arthur D. Cushman (U. S. Department of Agriculture), figures 5, 6, 41, 100-120 were prepared by Buxton, the remainder were prepared by Gurney.

Holotypes cited in this paper as being contained in the collection of the California Department of Agriculture, Sacramento, are to be deposited in the collection of the United States National Museum, Washington, D.C.

^{2/}

For financial assistance, the first author is indebted to the American Philosophical Society (Penrose Fund, 1964, Grant 3715).

A REVISION OF THE GENUS *KAROKIA*

Karokia Rehn, NEW STATUS

Karokia Rehn, 1964. Notulae Naturae, Philadelphia 368:1-9.

Proposed as subgenus of *Boonacris* Rehn and Randell; type-species, *Boonacris (Karokia) blanci* Rehn, by monotypy.

The members of this genus, among the more interesting and distinctive of Nearctic flightless grasshoppers, were entirely overlooked until the fall of 1963 when the first species was collected on Weaver Bally, Trinity County, California. (Several mountains in northern California have an Indian name of "bally" or "bolly".) They still are known only from this general area. Their distinctive generic nature has been further substantiated by a second species that has been discovered in the same area.

An analysis of numerous differences found between *Boonacris* and *Karokia* leads to the conclusion that they are distinct genera. The chief distinguishing characters we have noted are as follows: (1) Furcula of male short and lobelike in *Karokia*, usually slender and more elongate in *Boonacris* though extending over only a small part of the supra-anal plate (figs. 5-7); (2) each dorsal valve of ovipositor with apical excavate area, the "scoop", only about twice as long as wide in *Karokia*, much longer in *Boonacris* (figs. 14-16); (3) the pattern of aedeagal structures are different, as exemplified by the posteriorly directed, angulate portion of the dorsal valves of *Boonacris* (fig. 37, p. 14) which has no similar structure in *Karokia*; (4) ancrae of epiphallus small and far distant from lateral margins in *Karokia*, usually arising near lateral margins and conspicuously directed mesally in *Boonacris* (figs. 27, 29); (5) sclerite of basal fold consisting of 2 more or less elliptical, weakly sclerotized plates in *Karokia*, a pair of rectangular strongly sclerotized plates in *Boonacris* (figs. 1-4); (6) supra-anal plate of both sexes, especially the male, with conspicuous lateral prominences or transverse carinae at midlength in *Karokia*, prominences usually less conspicuous in *Boonacris* (figs. 5-7); (7) male cercus of *Karokia* with width at midlength narrower than typical *Boonacris* and without the ventral direction of the apical enlargement that usually occurs in *Boonacris* (figs. 17, 18, 21); (8) hind femur of *Karokia* more robust than that of *Boonacris*. Twelve representative specimens of each genus were measured, and the hind femoral length was found to average 3.7 times the width in *Karokia* in contrast to 4.4 in *Boonacris*.

The following key will help to show the distinctive characters of *Karokia* in relation to other genera of Melanoplinae, in the sense of Rehn and Randell (1963).

KEY TO THE GENERA OF THE SUPERTRIBE MELANOPLINI
WHICH LACK TEGMINA AND INHABIT THE PACIFIC COAST STATES

1. With a well developed tympanum on each side of abdominal tergum 1 2
Without a tympanum 5
2. Pronotum with prominent lateral carinae for at least part of the pronotal length (fig. 24). (Widely distributed from southern British Columbia and Montana to northern Arizona and northern California.). . . *Bradynotes* Scudder
Pronotum without lateral carinae 3
3. Male furcula usually slender fingerlike lobes (always so in the two Oregon species) though sometimes quite short (fig. 7); epiphallus usually with ancorae noticeably arising near lateral margins and directed mesally (fig. 29); dorsal valve of aedeagus with posteriorly directed angulate portion (fig. 37, *ppdv*); (Oregon; also in east near Great Lakes and from Prince Edward Island to Tennessee) *Boonacris* Rehn and Randell
Male furcula small, rounded, or with trigonal lobes (figs. 5, 6); epiphallus with ancorae not arising so far laterally and usually lacking such noticeable mesal direction (figs. 26-28, 30) 4
4. Supra-anal plate in both sexes with strong oblique carina or lateral prominences at midlength (figs. 5, 6, *lp*); epiphallus with each lophus narrow across dorsal apex (figs. 27, 28); basal fold of epiphallus with sclerotized areas (figs. 1, 2); male cerci slender at midlength, not broadly tapering to apex (figs. 17, 18). (northern one-fourth of California) *Karokia* Rehn
Supra-anal plate with little or no development of transverse carina or lateral prominences in either sex; epiphallus with each lophus wide across dorsal apex (fig. 26); basal fold of epiphallus entirely membranous; male cerci broader at midlength than above, usually broadly tapering to apex (figs. 19, 20). (British Columbia, Alberta, Washington, Montana, Idaho) . . . *Buckellacris* Rehn and Rehn
5. Male supra-anal plate with conspicuous dorsal prominences; female supra-anal plate usually with a distinct transverse carina about midlength; metasternal interspace of male about as wide as a lateral lobe. (Sierran regions of California, from Placer to Inyo Counties)
. *Hypsalonia* Gurney and Eades
Male supra-anal plate lacking dorsal prominences; female supra-anal plate without distinct transverse carina, though it sometimes is suggested at lateral margins;

metasternal interspace of male narrower than a lateral lobe 6

6. Lateral facial carinae strongly developed (fig. 25, 1fc); furcula absent; ventral valve of ovipositor with basal tooth (fig. 9, bt). (Olympic Peninsula of Washington) *Nisquallia* Rehn
Lateral facial carinae obsolete; furcula present, but small (fig. 8); ventral valve of ovipositor without basal tooth. (southern part of Sierra Nevada Mountains of California, mainly Tuolumne, Fresno, Tulare and Inyo Counties) *Hebardacris* Rehn

KEY TO THE SPECIES OF *KAROKIA*

1. Furcula of male consisting of very small lobes (fig. 5); anterior appendages of aedeagus with conspicuous lateral arms producing a T-like appearance in posterior view (fig. 40); scooplike portion of dorsal valves of ovipositor relatively broad in dorsal view (fig. 14); apical portion of ventral valves of ovipositor broad in ventral view (fig. 13); dorsal surface of body distinctly glossy *memorialis* Gurney and Buxton, sp. n.
Furcula of male consisting of lobes much larger than above (fig. 6); anterior appendages of aedeagus not as specialized as above description; lateral development pertaining to posterior appendages not to anterior appendages, no T-like appearance (fig. 41); both dorsal and ventral valves narrower than above (figs. 15, 12); dorsal surface of body usually dull, rarely shiny, at least in preserved dry specimens *blanci* Rehn

Karokia blanci Rehn NEW STATUS

(Figs. 1, 6, 11, 12, 15, 17, 22, 27, 32, 38, 41)

Boonacris (*Karokia*) *blanci* Rehn, 1964. Notulae Naturae, Philadelphia 368: 3-7, figs. 1-5, 9-12. (Weaver Bally, Trinity County, California, 6,900' elevation, G. M. Buxton, F. L. Blanc, September 25, 1963) (Holotype: male, California Department of Agriculture, Sacramento, California).

This species was described from 3 males and 3 females collected in 1963. The following additional specimens resulted from our 1964 trip. CALIFORNIA: 1 male, 3 females, Weaver Bally, Trinity County, September 8, 1964 (Buxton, Gurney, Thompson) (C.D.A. No. 64I29-29); 40 males, 14 females, Grizzly Meadows, Trinity County, September 10-15, 1964, associated with *Sedum obtusatum* Gray and *Angelica tomentosa* Wats. (Buxton, Gurney, Thompson) (C.D.A. No. 64I29-27); 24 males, 24 females, Grizzly Lake, Trinity County, September 11, 1964 (Buxton, Gurney, Forbes,

Kamp) (C.D.A. No. 64I29-28).

Specimens from Grizzly Meadows and Grizzly Lake do not differ from those collected at Weaver Bally. Because of the brief original description of the male genitalic complex, the following additional characters are listed:

Concealed genitalia with distinctive aedeagus; ventral valves (figs. 38, 41, vv) twisted, more strongly sclerotized basally, usually curving laterally at apex; anterior appendages on main stem (ms), apparently combined basally with sclerotized elements of dorsal valves, arising anterior to ventral valves, weakly sclerotized apically; epiphallus (fig. 27) with well developed ancorae; lophi erect (fig. 32).

KAROKIA MEMORIALIS Gurney and Buxton, sp. n.

(Figs. 2, 5, 13-14, 18, 23, 28, 30, 39, 40)

HOLOTYPE MALE: Wingless, size medium, form average for tribe Podismini, in sense of Rehn and Randell (1963).

Head in dorsal view with interocular distance in proportion to width of compound eye (as 3:8); fastigium shallowly sulcate and moderately declivent at about 35°; frontal costa almost flat and at its widest point broader than basal segment of antenna (as 5:4); flagellum apparently 20 articles, first 3 extremely short, some indistinctly formed.

Pronotum with slightly raised median carina on all portions, lateral carinae indistinct (on metazona less suggested than in *blaneii*), cut by 3 sulci, the posterior sulcus deepest and straight, the median sulcus curved slightly anteriorly, and the anterior sulcus shallow and straight, the anterior and posterior margin slightly indented at median carina.

Abdomen with distinct, but small median carina; tip conical. Legs robust.

Supra-anal plate (fig. 5) approximately as wide as long, lateral margins subparallel on proximal half, posterior to lateral elevations, curving abruptly toward apex which is slightly elevated; disk flat, apex with angle of about 90°; submedian longitudinal carinae parallel, prominent on proximal half, absent from distal half; proximal half with moderate depressions, distal half deeply depressed on either side of subapical disk. Furcula barely present as small knobs.

Concealed genitalia (KOH preparation in glycerine contained in microvial attached to specimen) with distinctive aedeagus; ventral valves (figs. 39, 40, vv) large, spirally twisting at base, broadly scooplike toward apex; main stem, evidently combined with sclerotized elements of dorsal valves, erect and weakly inclined posteriorly, with conspicuous lateral arms (la) poorly sclerotized apically and combining to appear as a "T" in posterior view. Epiphallus (figs. 28, 30) with ancorae reduced to blunt knobs; lophi tall, inclined forward, and narrowly truncate; basal fold with 2 separated irregular areas of weak brown-

ish sclerotization.

Coloration of head with most of dorsum, and thorax and first 3 abdominal terga dark brown, with darker mottling; following areas pale yellow: abdominal terga 4 to 10 (with brownish mottling in decreasing amounts), front and middle legs (arolium brown, claws black tipped), venter of thorax (some portions tinged with pinkish); hind femur red-orange ventrally and mesally, pale yellow laterally except for dark brown genicular crescent and brownish-red lower marginal area, pale yellow dorsally except for 2 dark brown transverse bars and indistinct basal and apical bars; hind tibia pale grayish-red.

Measurements (in millimeters): length of body, 18.8; pronotum, 3.5; hind femur, 9.8; front femur, 4.2; greatest width of pronotum, 4.4; hind femur, 3.0; front femur, 1.3.

ALLOTYPE FEMALE: Same data as holotype. (United States Nat. Mus.). Considerably larger and more robust than male. Head in dorsal view with interocular distance in proportion to width of compound eye (as 3.5:6); pronotum with less distinct median carina than in male, sulci and margins similar to male; cercus 2.5 times as long as wide, more blunt than in *K. blanci* (figs. 22, 23); ovipositor valves more robust in both dorsal and ventral views (figs. 13-14) than in *blanci*. Coloration somewhat darker than holotype and less contrasting between dark brown and pale yellow areas.

Measurements (in millimeters): length of body, 24.0; pronotum, 4.2; hind femur, 12.5; front femur, 4.3; width of pronotum, 5.4; hind femur, 3.3; front femur, 1.1.

Specimens examined: CALIFORNIA: 3 males, 7 females, holotype, allotype, paratypes. Holotype male: Grizzly Lake, Trinity County, "Ex. granite and serpentine" September 11, 1964, (Buxton, Gurney, Forbes, Kamp), (C.D.A.No. 64I29-28), (United States Nat. Mus., Type No. 69,681). All specimens bear the same data as the holotype, except that one female paratype was taken by J. W. Kamp on glacial snow at about 8,000' elevation on the steep slope south of Grizzly Lake. The remainder were collected near the northern edge of the lake at an elevation of about 7,500'.

Variation: All paratypes are closely similar in color, some averaging darker than others, all with the same pattern of dark and pale areas. More pronounced pinkish areas in some cases may be due to killing with cyanide. All are noticeably glossy on the dorsal body surface.

Male paratypes are approximately the same size as the holotype; one is slightly larger; length of body, 20.0; pronotum, 3.6; hind femur, 10.5. Female paratypes do not vary widely in size; the extremes and averages of 6 are as follows: length of body, 23.8-25.5, average, 24.5; pronotum, 4.3-4.7, average, 4.5; hind femur, 12.3-13.0, average, 12.6.

Significant non-keyed differences between *blanci* and *memorialis* are figured. Male cercus of *memorialis* is longer, apically differentiated (figs. 17, 18). Female cercus of *blanci* is more acute, apically concave dorsally and ventrally (figs. 22-23). The lophi of epiphallus of *blanci* are differentiated from *memorialis* (figs. 31, 32). In *blanci*, the dorsal surface of the

hind tibia distad of the pale subbasal annulus is dark, often blackish olivaceous, but in *memorialis*, it is usually pale, varying from yellow to pinkish gray.

The name *memorialis* is given in remembrance of Harold J. Grant and James A. G. Rehn. The former lost his life in a tragic drowning accident just as his career was coming into full flower; the latter was a dedicated "dean" of our science who succumbed to the infirmities of age after contributing steadily to the systematics of Orthoptera for 65 years.

THE *SALTATOR* SPECIES-GROUP OF THE GENUS *MELANOPLUS*

This group occurs from central Washington to southern California, and there is one record from western Nevada, but most collections have been made in western Oregon and northern California (fig. 42). All species are short-winged and flightless; the tegmina usually extend onto the second tergum or scarcely further posteriorly, and their apices are rounded but not broadly so. With the exception of the southern California *Melanoplus bernardinoe* Hebard which has a short and weakly upturned male cercus (Gurney, 1960, fig. 88), male cerci of this group (figs. 43-50) are elongate and directed partly ventrally at the apex. There is a distinctive pattern of the aedeagus; the dorsal valves are slender, elongate, and erect, and each one has a thin or membranous marginal expansion of variable width that may not be conspicuous. The ventral valves are visible as thin, straplike structures, each with its apex curling briefly about the base of and anterior to the corresponding dorsal valve. There is also a small spinelike projection, evidently part of the dorsal valve, near each ventral valve. Most species of the group are characterized by strong submarginal distal ridges which curve laterally at their anterior ends and are located in the apical half of the supra-anal plate (figs. 51-54, 56-58), but a few species have the ridges differently shaped (fig. 55; G1960, figs. 83, 89). Color of the hind tibia in the various species may be blue, olive, dirty gray, or red and is sometimes variable within a single species.

The characters we have found most useful for distinguishing species, (all restricted to adult males) are cerci, distal ridges of supra-anal plate, aedeagus, and rami of the cingulum. The rami, a character that has not previously been used in *Melanoplus*, are distinctive in the number and shape of prominences visible in lateral view and the degree of lateral flaring evident in posterior view. The sclerite of the dorsal fold, located posterior to the epiphallus and anterior to the aedeagus, is well developed in this group, and, though it is not possible to distinguish most species by this character alone, some identifications can be partially confirmed by the shape of this sclerite, and, in a few others it is distinctive. This sclerite, too, is a new specific character for *Melanoplus*.

This species-group occurs on rangeland and open woodland areas for the most part. There is one record of *saltator* Scudder feeding on a mint, but no other host plant data have come to our attention, and so far as known the group is of secondary economic importance. Most adult collections have occurred in August and September, but dates on specimens of *elaphrus* Strohecker range from August 17 to November 2, and on *ostentus* sp. n., from July 14 to October 7. At high elevations, frosts may limit grasshopper activity by mid to late fall.

Previous comprehensive work on the *saltator* group began with Hebard (1937) who utilized the aedeagus to some extent and had specimens from many more localities than had been assembled before. However, he did not publish a key or distribution map, and his dry preparations of the genital complex did not permit comparison of some structures now seen to be distinctive. Strohecker (1963) offered a key and made a more detailed study of the genital complex than Hebard did. Thompson and Buxton (1964) provided a list of the California species.

The location of holotypes and lectotypes of the group, a total of 14, including 3 synonyms and one new species, is as follows: Museum of Comparative Zoology, 6; Academy of Natural Sciences of Philadelphia, 2; United States National Museum, 6.

Our present work has not yielded evidence of intergradation so we do not recognize subspecies (as Hebard did). However, future collections should be made with the possibility of intergradation in mind, and efforts should also be made to enlarge the representation from Washington and to obtain new records from Nevada. There is need for host plant information and other data to round out an understanding of the group's ecology.

KEY TO SPECIES OF *SALTATOR* GROUP OF *MELANOPLUS* (MALES ONLY)

1. Cercus less than twice as long as its basal width, not (or feebly) enlarged at apex, weakly upturned (Gl960, fig. 88); supra-anal plate with low subparallel distal ridges (Gl960, fig. 89); (San Bernardino and Riverside Counties, California). *bernardinae* Hebard
Cercus at least twice as long as its basal width 2
2. Cercus tapering, not (or very slightly) enlarged at apex (figs. 43-45). 3
Cercus not tapering, instead enlarged at apex (figs. 46-50; Gl960, fig. 82) (Gl960 refers to Gurney 1960) 5
3. Lateral margins of supra-anal plate near base with sinuate carinae (fig. 55, slc), distal ridges of supra-anal plate parallel; (Glenn County, California) *buxtoni* Strohecker
Lateral margins of supra-anal plate without sinuate carinae; distal ridges with anterior ends reaching lateral margins (figs. 51, 57) 4

4. Cercus weakly enlarged subapically, obliquely truncate at apex (fig. 45); distal ridges of supra-anal plate strongly converging in their apical halves (fig. 51); (Trinity County, California). *elater* Strohecker
 Cercus without enlargement near apex (fig. 44); distal ridges of supra-anal plate nearly parallel in their apical halves (fig. 57); (Humboldt County, California). *elaphrus* Strohecker

5. Distal ridges of supra-anal plate with convex side lateral, curving toward lateral margins from close proximation near apex (Gl960, fig. 83); dorsal valves of aedeagus conspicuously elongate (figs. 60, 71); (northern Oregon to northern Sierra Nevada Mountains, California). *lepidus* Scudder
 Distal ridges of supra-anal plate with convex side mesal (figs. 52, 53); dorsal valves of aedeagus not so conspicuously elongate as above. 6

6. Distal ridges of supra-anal plate at their anterior ends meeting lateral margins of plates or, if not, without a pronounced depression or interruption between the end of distal ridges and the margin (figs. 52, 56, 58). . . . 7
 Distal ridges of supra-anal plate separated from lateral margins by a definite, though sometimes small depression or interruption (figs. 53, 54, de). 9

7. Ramus of cingulum specialized; lateral view shows a central "knob" at dorsal margin (figs. 67, 68, kn). 8
 Ramus specialized differently from above, without a central "knob" at dorsal margin, instead a separate lobe occupies the posterior three-quarters of dorsal margin (fig. 69); (western Oregon, central Washington). . . *validus* Scudder

8. Cercus sharply oblique at apex, ventral point rather prolonged (fig. 50); ramus with knoblike lateral projection small and round (fig. 68); (western Oregon, distant from California boundary). *calapooyae* Hebard
 Cercus with ventral point at apex (fig. 46) shorter than above; ramus with lateral projection larger than above and much lower than anterior part of dorsal margin (fig. 67); (southwestern Oregon, northeastern California). *ascensus* Scudder

9. Aedeagus with dorsal valve bearing a large brown, well sclerotized, triangular lobe anteriorly (fig. 66, tl); main stem with conspicuous lobelike expansion extending posteriorly and dorsally (fig. 66, lle); ramus with elongate projection or wide "knob" in lateral view, conspicuously flaring in posterior view (fig. 77); (Del Norte County, California). *ostentus* Gurney and Buxton, sp. n.

Aedeagus with dorsal valves not bearing a dark sclerotized lobe anteriorly though a membranous marginal portion may occur (figs. 64, 65); ramus without projection or "knob" in lateral view though flaring in posterior view may occur. 10

10. Distal ridges of supra-anal plate high in comparison with lateral margins; rami strongly flaring laterally in posterior view (fig. 76); apex of tegmen broadly and moderately rounded; (northwestern Oregon). . *saltator* Scudder
- Distal ridges of supra-anal plate not exceeding lateral margins in height; rami not flaring laterally in posterior view (fig. 75); apex of tegmen acute; (northwestern and north central California). . . . *siskiyou* Strohecker

Melanoplus ascensus Scudder

(Figs. 42, 46, 56, 67, 78, 81, 97)

Melanoplus ascensus Scudder, 1899. Proc. Davenport Acad. Nat. Sci. 7:196, pl. 9, fig. 3. (Type locality, by selection of Rehn and Hebard, 1912: Mount Shasta, northern California, just below the forest line), (Lectotype: Male, Museum of Comparative Zoology). A male at the Museum of Comparative Zoology, labelled as lectotype, examined in February 1965, has data "Mt. Shasta, Calif. Aug. 31, 1897. H. Cp." The only date mentioned for Mt. Shasta by Scudder (1899) was September 2.

Melanoplus validus pinicola Fulton (1930: 622, fig. 1, M). Type locality, by original designation, "West side of Klamath Lake, Oregon." Synonym indicated by Hebard (1937: 150). The male type in the United States Nat. Mus. shows the validity of synonymy.

Melanoplus debilis Scudder (1899: 201, pl. 9, fig. 7). NEW SYNONYMY. Type locality, by selection of Rehn and Hebard (1912: 90), Ashland, Oregon. Synonymy is herein indicated, based on examination of topotypes and a paralectotype from Siskiyou, Oregon. The male lectotype is in the Museum of Comparative Zoology. Hebard (1937: 151) placed *debilis* as a synonym of *validus*, apparently based on only partial comparisons of the male genital complex.

Subsequent references: Woodworth (1902:19); Rehn and Hebard (1912: 90); Fulton (1930: 621), (footnote); Hebard (1937: 150, pl. 10, fig. 2); Gurney (1960: 163); Strohecker (1963: 164, 165, 171, figs. 24, 25, 29, 45); Thompson and Buxton (1964: 38, 40).

Distribution of material examined: CALIFORNIA: Dismal Swamp, Cave Lake (1 mile northwest of Fandango Pass), Modoc County; Juniper Lake (southwest corner of county), Lassen County; 10 miles north of Bartle, Mt. Shasta, Siskiyou County; OREGON: Klamath Lake, Klamath County; Medford, Ashland, Siskiyou, Jack-

son County.

All of the California localities listed above (except Juniper Lake) represent our 1964 collecting. In each place, we found *ascensus* in small numbers in rather dry scrubby brushland, and at the Dismal Swamp site it was among sagebrush and other semidesert shrubs a few hundred yards from a wet area. Persistent efforts were needed to collect more than a few specimens.

Melanoplus bernardinae Hebard

(Figs. 42, 62, 73)

Melanoplus bernardinae Hebard, 1920. Trans. American Entomol. Soc. 46: 388, pl. 17, figs. 9, 10. (Type locality, by original designation: Vivian Creek, San Bernardino Mountains, Riverside County, California, 7,200' elevation), (Holotype: Male, Academy of Natural Sciences of Philadelphia).

Subsequent references: Hebard (1935: 363); Gurney (1960: 161, 164, figs. 84-89); Strohecker (1963: 164-166); Thompson and Buxton (1964: 38, 40).

Distribution of material examined: CALIFORNIA: Vivian Creek, Riverside County.

Hebard (1920) recorded *bernardinae* from several localities in the San Bernardino and San Jacinto Mountains, and Strohecker (1963) added one locality in each mountain area.

This species is atypical of the *saltator* group because of its extreme southern distribution in California, for the short and slightly upturned male cercus, and for the weak development of specialized carinae on the disk of the apical half of the male supra-anal plate. However, the structures of the aedeagus (figs. 62, 73) indicate the group affinity. The sclerite of the dorsal fold has not been illustrated because the single preparation examined does not show the sclerite distinctly. Apparently, it consists of a pair of large broad plates that lack sharp features or strong sclerotization.

Melanoplus buxtoni Strohecker

(Figs. 42, 43, 55, 59, 70, 83, 99)

Melanoplus buxtoni Strohecker, 1963. Pan-Pacific Entomol. 39: 164, 168, figs. 15-18, 21. (Type locality, by original designation, Plaskett Meadows, Glenn County, California), (Holotype: Male, California Department of Agriculture, Sacramento, California).

Subsequent references: Thompson and Buxton (1964: 38, 41).

Distribution of material examined: CALIFORNIA: Plaskett Meadows, Glenn County.

On September 24, 1964, Helfer and Gurney collected several specimens of *buxtoni* in the "Seven Troughs" section of Plaskett

Meadows in the extreme northwestern corner of Glenn County. This is high range country with an elevation of about 5,000'. The grasshoppers were taken on a dry open hillside near the Alder Springs Road, which bears dry grasses, scattered shrubs and small trees. The key characters permit the ready recognition of this localized species.

Melanoplus calapooyae Hebard

(Figs. 42, 50, 58, 68, 79, 86, 96)

Melanoplus calapooyae Hebard, 1920. Trans. American Entomol. Soc. 46: 385, pl. 17, fig. 8, pl. 18, fig. 8. (Type locality, by original designation: Divide, Calapooia Mountains, Lane County, Oregon, elevation 1,400' to 1,600'), (Holotype: Male, Academy of Natural Sciences of Philadelphia).

Subsequent references: Frison (1927: 142). Record of 2 paratypes of *calapooyae* in Illinois Nat. Hist. Surv. Coll.; Fulton (1930: 621); Hebard (1937: 152, pl. 10, fig. 4); Gurney (1960: 159, fig. 93); Strohecker (1963: 164, 165, 171, figs. 26, 27, 30, 46); Thompson and Buxton (1964: 38, 40).

Distribution of material examined: OREGON: Divide, Roseburg, Douglas County.

Hebard (1937) listed localities, including two in central Washington, corresponding to 5 segregates of material, sorted by what he regarded as variation of *M. ascensus calapooyae*. Although we have not examined material from all of Hebard's localities, it appears certain that at least three species were represented. Three of Hebard's localities concerning specimens from central Washington have proven to be *Melanoplus validus*.

The male cercus has the ventral development of the apical portion strongly developed, but it is somewhat variable, and the occurrence of a typical "knob" on the ramus of the cingulum (fig. 68) is important in recognition of this species.

Melanoplus elaphrus Strohecker

(Figs. 42, 44, 57, 63, 74, 90, 92)

Melanoplus elaphrus Strohecker, 1963. Pan-Pacific Entomol. 39: 164, 169, figs. 19, 20, 33. (Type locality, by original designation: 3 miles east of Kneeland, Humboldt County, California), (Holotype: Male, California Department of Agriculture, Sacramento, California).

Subsequent references: Thompson and Buxton (1964: 38, 42).

Distribution of material examined: CALIFORNIA: Cold Springs (South Fork Mountains), Trinity County; 3 miles east of Blue Lake, 3 miles east of Kneeland, Ferndale, Humboldt County.

In addition to the characters in the key, a distinctive character of *elaphrus* is the broad peculiarly shaped sclerite of

the dorsal fold (fig. 90).

Melanoplus elater Strohecker

(Figs. 42, 45, 51, 61, 72, 82, 98)

Melanoplus elater Strohecker, 1963. Pan-Pacific Entomol. 39: 164, 166, figs. 11-13. (Type locality, by original designation: 5 miles northeast of Zenia, Trinity County, California), (Holotype: Male, California Department of Agriculture, Sacramento, California).

Subsequent references: Thompson and Buxton (1964: 38, 42).

Distribution of material examined: CALIFORNIA: 3 miles northeast of Zenia, Trinity County.

This species is a close relative of *elaphrus*, from which it can be separated easily by the shape of the cercus (fig. 45). Although in the only preparation of the genital complex we have seen, the sclerite of the dorsal fold is asymmetrical and obviously imperfectly formed, it clearly differs from that of *elaphrus* (fig. 90). The aedeagus is nearly similar in both species, but in *elater* the spinelike projection at the base of each dorsal valve is more noticeable than in *elaphrus*.

Melanoplus lepidus Scudder

(Figs. 42, 60, 71, 85)

Melanoplus lepidus Scudder, 1897a. Proc. American Phil. Soc. 36 (154): 15, 34; Proc. United States Nat. Mus. 20: 129, 321, pl. 21, fig. 9, 1897b, (Type locality, selected by Rehn and Hebard, 1912: Truckee, Nevada County, California), (Lectotype: Male, Museum of Comparative Zoology).

Subsequent references: Rehn and Hebard (1912: 86); Hebard (1919: 282), (1935: 367); LaRivers (1948: 695) [quotation of early records]; Gurney (1960: 163, figs. 77-83); Strohecker (1963: 164, 169); Thompson and Buxton (1964: 38, 43).

Distribution of material examined: CALIFORNIA: Sugar Hill (Goose Lake) (5 miles southwest of Buck Creek Ranger Station, Warner Mountains, east and a little north of south end of Goose Lake), Modoc County; Truckee, Nevada County; 9 miles northwest of Canyon Dam, Harkness Peak, Plumas County; Shingletown, Shasta County; Butte Meadows, Tehama County.

Scudder (1897b) recorded *lepidus* from the Humboldt River, Nevada, an inexact locality because of the length of that river, so occurrence in Nevada remains somewhat uncertain. Scudder (1897a) provided a key to *Melanoplus lepidus*; the actual description is found in Scudder (1897b).

Hebard (1935) recognized the *lepidus* group for the species and several congeners. However, Gurney (1960) transferred *lepidus* and *bernardinae* to the *saltator* group because of the basic pattern of the aedeagus. The distribution of *lepidus* is more

extensive than that of other members of the species-group. It is recognized by the distal ridges of the male supra-anal plate, which are developed only moderately strongly and are convex laterally, by the elongate dorsal valves of the aedeagus, and by the nonflaring appearance of the rami of cingulum in a posterior view.

MELANOPLUS OSTENTUS Gurney and Buxton, sp. n.

(Figs. 42, 48, 53, 66, 77, 84, 91)

HOLOTYPE MALE: Size medium for group.

Head in dorsal view with ratio of interocular distance to width of compound eye (as 6:17); fastigium moderately flat in lateral view, shallowly sulcate.

Pronotum with anterior margin straight, posterior margin moderately rounded, median carina obscure in central area, cut by 3 sulci, anterior pair parallel and shallow, posterior main sulcus deep and curved anteriorly, complementing posterior margin with approximately same curvature; length ratio of median carina on prozona and metazona 26:22. Tegmina barely shorter than pronotum, not overlapping, apex feebly produced and narrowly rounded.

Supra-anal plate slightly longer than wide with sides converging slightly on basal three-fifths, converging sharply on apical two-fifths, and meeting abruptly at approximately 85°; central trough running longitudinally entire length, deep, quite even; furculae small, projecting laterally; distal ridges moderately high, separated from respective margins of plate by low depression (fig. 53, *de*). Cercus (fig. 48) broad at base, constricted evenly at midlength to two-thirds basal width, evenly expanded distally to approximately basal width, ventrodistal area slightly expanded.

Aedeagus (extracted and preserved in glycerine), (figs. 66, 77), with each dorsal valve bearing anteriorly a large, brown, well sclerotized triangular lobe; main stem with conspicuous lobelike expansion extending posteriorly and dorsally; ramus with elongate projection or wide "knob" in lateral view, conspicuously flaring in posterior view. Epiphallus (fig. 91) with slender, tapering sinuate lophi, moderately separated; bridge wide.

Coloration dorsally with ground color brownish-yellow, light yellow ventrally; heavy dark mottling on dorsum of head, thorax, and abdomen; wide black stripe extending from behind eye on head across lateral surface of prozona and front surface of metazona, obscure on posterior half of metazona, continuing on pleura and abdomen to tergum 5; front and middle femora light yellow with brown mottling; hind femora with dark brown "chevrons" covering most of outer median area, mesal surface yellow with two dark patches on dorsal half, dorsal surface with 3 blackish areas. Hind tibia reddish, spines black, claws black-tipped, pulvilli brown.

Measurements (in millimeters): Length of body, 19.0; pronotum, 4.1; front femur, 3.5; middle femur, 3.7; hind femur, 9.6; tegmen, 3.7. Greatest width of pronotum (posteriorly, including lateral lobes in dorsal perspective), 3.2; front femur, 0.8; middle femur, 0.9; hind femur, 2.6; tegmen, 2.0.

ALLOTYPE FEMALE: 7 miles (approximation of airline distance) northeast of Smith River, Del Norte County, California, October 7, 1963, (T.R. Haig and J.W. Anderson), C.D.A.No. 63J16-24, (United States Nat. Mus.). More robust than male. Head in dorsal view with ratio of interocular distance to width of compound eye 7:16; fastigium broader than in male, smooth to barely sulcate; disc of pronotum much broader than in male; tegmina broader than in male, slightly overlapping; median carina with ratio of prozonal and metazonal length 24:20; principal sulcus crosses median carina at right angle; cercus symmetrical, blunt, twice as long as wide; dorsal valve of ovipositor with medium sized "scoop" and small crenulations. Coloration dorsally with ground color considerably lighter than in holotype, with brown mottling on buff background; markings placed as in holotype but dark brown rather than black; tips of dorsal ovipositor valves black.

Measurements (in millimeters): Length of body, 21.0; pronotum, 4.5; tegmen, 4.6; hind femur, 11.0. Greatest width of pronotum, 4.0; tegmen, 2.7; hind femur, 2.8.

Variation: Five male and five female paratypes have been measured (in millimeters) with results as follows: Length of body of males, 18.3-19.5, average, 18.7; of females, 18.1-22.1, average, 20.4; of pronotum of males, 3.6-4.2, average, 3.9; of females, 4.3-4.7, average, 4.6; hind femur of males, 8.9-9.8, average, 9.5; of females, 10.2-11.5, average, 10.9.

Specimens examined: CALIFORNIA: Del Norte County: 11 males, 7 females, holotype, allotype, paratypes. Holotype male: Pine Flat, 17 miles northeast of Smith River (by road), Del Norte County, California, 3,200' elevation, August 18, 1963, ex. pine mat, manzanita, dwarf juniper, (L.M. Jensen and T.O. Peacock), C.D.A.No. 64H20-4. (United States Nat. Mus., Type No. 69,682). Three males, Pine Flat, 17 miles northeast of Smith River (by road), 3,200' elevation, August 18, 1963, ex. pine mat, manzanita, dwarf juniper, (L.M. Jensen and T.O. Peacock), C.D.A.No. 64H20-4; 1 male, 2 females, 7 miles (approximation of airline distance) northeast Smith River, October 7, 1963, T.R. Haig and J.W. Anderson), C.D.A.No. 63J16-24; 3 males, 5 females, 13 miles northeast of Smith River, October 2, 1963, (T.R. Haig), C.D.A.No. 63J16-24; 4 males, Siskiyou National Forest, July 14, 1935, (R.H. Beamer).

George W. Byers, University of Kansas, has consulted Dr. Beamer's diaries and reports that the last material evidently was collected near Madrona Camp; this locality is about 10 miles east of Gasquet, Del Norte County, located in what is now known as the Six Rivers National Forest. Hebard (1937: 153) reported specimens of what probably is the same species, identified by

him as *M. ascensus calapooyae*, from "Medione Camp." The latter is obviously a misspelling of Madrona, and we are fortunate to have been able to clarify this matter by locating Madrona Camp on a detailed map of the Forest.

The specific name *ostentus* is adapted from a Latin word meaning "spread out" or "displayed", with reference to the triangular extension on the anterior margin of each dorsal valve.

Melanoplus saltator Scudder

(Figs. 42, 65, 76, 89, 93)

Melanoplus saltator Scudder, 1897a. Proc. American Phil. Soc. 36(154): 14, 34; Proc. United States Nat. Mus. 20: 129, 261, pl. 17, fig. 8, 1897b. (Type locality, by selection of Rehn and Hebard, 1912: Portland, Oregon), (Lectotype: Male, Museum of Comparative Zoology).

Melanoplus algidus Scudder (1899: 199, pl. 9, fig. 6). Type locality, by original designation, Mary's Peak, Benton County, Oregon. Synonymy indicated by Fulton (1930: 621) and Hebard (1937: 149), and is supported by our examination of a paralectotype from Mary's Peak. The male lectotype of *algidus*, by selection of Rehn and Hebard (1912), is in the Museum of Comparative Zoology.

Subsequent references: Essig (1926: 84); Fulton (1930: 620); Mote (1933: 226); Hebard (1937: 149, pl. 10, fig. 1); Emslie (1943), [Recorded from eastern Washington]; Gurney (1960: 163, figs. 90-92); Strohecker (1963: 165, 172, figs. 38, 39, 41, 42); Helfer (1963: 257, 259, 260).

Distribution of material examined: OREGON: Corvallis, Mary's Peak, Benton County; between Brightwood and Cherryville, Clackamas County; Crabtree, Linn County; Portland, Multnomah County.

Scudder (1897b: 261) referred to various early records of *saltator* made under the name *Pezotettix borekii* Stal. The Portland, Oregon specimens noted by Scudder (1880: 24, pl. 17, fig. 17) were of *saltator*, then undescribed. Scudder (1896: 66) referred to *saltator* in Washington, Idaho, Montana, and Wyoming, when the name was in manuscript. Records of "*borekii*" from Montana, Idaho, and Wyoming by Bruner (1884: 58) referred to other species, as also apparently did his record from eastern Washington Territory (Bruner, 1885: 12). On the basis of these records, several of the localities cited by Scudder (1897b: 262), especially Loon Lake, Washington, are probably incorrect, as was the distribution (Oregon, Washington, Montana, Idaho, Wyoming) attributed to *saltator* by Kirby (1910: 520). *M. saltator* is restricted to northwestern Oregon with a possible extension into southwestern Washington.

M. saltator, the best known of the species-group, is most easily distinguished by the high distal ridges of the male supra-anal plate. These ridges are well separated from the lateral

margins at their anterior ends, by a moderate enlargement of the cercus, much as in *ostentus* (fig. 48), and by the ramus of the cingulum which flares markedly in posterior view (fig. 76). No separate "knob" is visible in lateral view.

Mote (1933) reported *saltator* damaging a field of mint at Jefferson, Oregon on July 10; no further details are available.

Melanoplus siskiyou Strohecker

(Figs. 42, 47, 54, 64, 75, 87, 94)

Melanoplus siskiyou Strohecker, 1963. Pan-Pacific Entomol. 39: 164, 170, figs. 14, 36, 37, 40. (Type locality, by original designation: Fort Jones, Siskiyou County, California), (Holotype: Male, California Department of Agriculture, Sacramento, California).

Subsequent references: Thompson and Buxton (1964: 38, 45).

Distribution of material examined: CALIFORNIA: Mt. Shasta, Mt. Eddy, Fort Jones, Siskiyou County; Grizzly Meadows, Morrison Gulch, Strunce Cabin (3 latter locations north of Helena on trail to Thompson Peak), Weaver Bally, Cold Springs Lookout (South Fork Mountains), Trinity County.

It is interesting that both *ascensus* and *siskiyou* have been taken at Mt. Shasta. We have examined the lectotype of *ascensus* collected "just below the forest line," and also a male of *siskiyou* collected at an elevation of 5,500' in "glades of deep grasses near water" on August, 14, 1909 and in the collection of the Academy of Natural Sciences, Philadelphia. In our 1964 collecting trip, we worked only a little on Mt. Shasta and found neither species. The closest the two species approached sympatry was the occurrence of *siskiyou* at Mt. Eddy and *ascensus* at a point 10 miles north of Bartle, these sites separated by about 35 miles. Mt. Shasta occupies an extensive area, and there is no certainty that *siskiyou* and *ascensus* occur in identical localities or environments there.

In addition to differences in the distal ridges of the supra-anal plate (utilized in the key to separate *ascensus* from *siskiyou*), the differences in the rami of the cingulum are particularly useful in distinguishing the two species. The sclerite of the dorsal fold of the male genital complex seems definitely to distinguish *siskiyou* from *saltator* also.

Melanoplus validus Scudder

(Figs. 42, 49, 52, 69, 80, 88, 95)

Melanoplus validus Scudder, 1899. Proc. Davenport Acad. Nat. Sci. 7: 197, pl. 9, figs. 4, 5. (Type locality by selection of Rehn and Hebard, 1912: Grant's Pass, Oregon), (Lectotype: Male, Museum of Comparative Zoology).

Subsequent references: Rehn and Hebard (1912: 90); Fulton

(1930: 621); Hebard (1937: 151, pl. 10, fig. 3); Gurney (1960: 163); Strohecker (1963: 164, 165, 171, figs. 22, 23, 31, 44); Thompson and Buxton (1964: 38, 40).

Distribution of material examined: OREGON: Tombstone Prairie [on Highway 20 near summit; see Rehn and Randell (1962: 161, footnote)], Linn County; Scott (probably just east of Crater Lake), Crater Lake, Klamath County; Umpqua Hot Springs, Glendale, Douglas County; Woodruff Meadows (about 30 miles southwest of Crater Lake: see Fulton, 1930: 628, 636), north of Trail (on Rogue River at mouth of Trail Creek), Jackson County; Grant's Pass, Josephine County.

Hebard (1937: 151) regarded *Melanoplus debilis* Scudder as a synonym of *validus*, but, as discussed here under *M. ascensus* Scudder, we regard *debilis* as a synonym of *ascensus* instead. Hebard commented on the corrected identity of specimens from several of Scudder's original *validus* localities. Fletcher and Gibson (1908: 131) and Walker (1910: 337) recorded *validus* from Nelson, British Columbia, but Buckell (1922:33) quoted E. M. Walker as believing the record to be based on material of *M. washingtonius* Bruner. The original Nelson material apparently was limited to a single female. Walker visited Nelson in 1920 and collected several males and females which he considered *washingtonius*. It is now known, however, that more than one species of the *montanus* species-group, (which contains *washingtonius*), occurs in British Columbia, so a detailed examination of the aedeagus is necessary to be certain of the identity of the Nelson population.

The cercus of a single *validus* male from Tombstone Prairie is less produced ventrally at the apex than in other males examined, but the aedeagus is typical, and we therefore conclude that variation in the cercus occurs.

THE *IMMUNIS* SPECIES-GROUP OF THE GENUS *MELANOPLUS* IN OREGON AND CALIFORNIA

As discussed by Gurney (1960), the *immunis* group may be regarded broadly to include species from Utah, Arizona, and New Mexico, but now, as then, those in Oregon and California are discussed in particular because of the relationships of several new species that have been collected in recent years. All species are short-winged and incapable of flight; the tegmina of all Oregon and California males either overlap dorsally or are attingent or nearly so, and they usually extend part way across the second tergum. Cerci of the Oregon and California males are most often spatulate, sometimes shortened and curved dorsally with moderately specialized apex, and less often weakly curved ventrally. The male supra-anal plate is relatively unspecialized in this group, and the furcula is small except for *wilsoni* Gurney. Dorsal valves of the aedeagus are located posterior to the apical portion of the main stem, usually closely attached to the latter; ventral valves are located posterior to the dor-

sal valves and usually are thin and parchmentlike, rarely heavily sclerotized (as in *immunis* Scudder), and highly specialized. As a group, color of the hind tibia is variable.

Species of the *immunis* group superficially resemble those of the *saltator* group, which in Oregon and California often occur near each other, but the ventral valves of the aedeagus of the *saltator* group are visible anterior to the main stem and curling about its base. Also, most species of the *saltator* group have prominent submarginal ridges in the apical half of the supra-anal plate. Male cerci differ considerably for the species for each of the two groups to permit ready group assignment by this character, as will be evident from illustrations shown in this paper and accompanying the papers cited.

Likewise, commonly encountered with the *immunis* group are species of the genus *Oedaleonotus*; the short-winged species of *Oedaleonotus* tend to be more robust and to have definite lateral carinae or "square shoulders" on the pronotum; also the male cerci have narrow apical portions distad of a bulbous base. The most useful characters for recognizing the different species of the *immunis* group occur in the cerci, aedeagus, and supra-anal plate of males. To avoid duplication of illustrations, readers are referred to Gurney (1960).

Terrain occupied by the *immunis* group varies with the species from lowland grassy areas (near woodland borders or among shrubs), to hilltop prairies, and to steep slopes at 4,000 to 5,000' elevation or more (amid tall firs or alpine undergrowth and dead leaves). Although most collection records for capture of adults in this group are for mid-July into October, there are a few records in May and one as late as December 20.

The *immunis* group in relation to other groups of brachypterous species of *Melanoplus*, especially the group as it occurs in Oregon and California, was reviewed by Gurney (1960). Since then, Strohecker (1963) added three species from California, and Thompson and Buxton (1964) listed the California species.

The location of holotypes and lectotypes of the group from Oregon and California, a total of 14 (including 1 synonym and 3 new species) is as follows: United States National Museum, 6; California Department of Agriculture, 3; Museum of Comparative Zoology, 3; Academy of Natural Sciences of Philadelphia, 2.

Eight of these 13 species are known from only one locality each, and only two (*caroli* Gurney and Helfer, *immunis* Scudder) have any significant recorded distributional spread, so it is obvious that more collecting is needed before our understanding of the group can be considered well rounded.

KEY TO THE *IMMUNIS* SPECIES-GROUP OF *MELANOPLUS*
FROM CALIFORNIA AND OREGON (MALES ONLY)

1. Cercus curved ventrally near apex (Gl960, figs. 12, 21). .2
Cercus not curved ventrally though in some species spatulate cerci (Gl960, figs. 43-45) show ventral direction of ventral margin 3
2. Dorsal valves of aedeagus extending dorsad of main stem (Gl960, fig. 15); ventral curvature of cercus only moderately developed; (southwestern Oregon). *lovetti* Fulton
Dorsal valves of aedeagus not extending dorsad of main stem (Gl960, fig. 18); ventral curvature of cercus more strongly developed; (area of Yosemite National Park, California). *ablutus* Scudder
3. Cercus relatively short and broad for group, angularly directed dorsally in apical third (figs. 112, 118; Gl960, figs. 4, 11); (western Oregon). 4
Cercus usually more slender than proceeding (Gl960, figs. 43-45), *or*, if not (fig. 103), dorsal angulation less pronounced; (California). 7
4. Aedeagus with ventral valves very elongate, directed anteriorly at their apices (Gl960, figs. 5, 6). *immunis* Scudder
Aedeagus not as above. 5
5. Aedeagus in posterior view with 4 dorsal projections at apex (Gl960, fig. 8). *rehni* Hebard
Aedeagus not as above. 6
6. Cercus sharply rounded at apex (fig. 112); supra-anal plate narrowly triangular, with very small furcula (fig. 109); aedeagus as in figs. 110, 111. *kasadi* Gurney and Buxton, sp. n.
Cercus more evenly rounded at apex (fig. 118); supra-anal plate basally about as wide as total length, with larger furcula (fig. 115); aedeagus as in figs. 116, 117. *goedeni* Gurney and Buxton, sp. n.
7. Supra-anal plate wider than long 8
Supra-anal plate longer than wide 9
8. Furcula very small (fig. 102); aedeagus with ventral valves in posterior view narrowly visible near apex of main stem (fig. 104); (extreme northwestern California *haigi* Gurney and Buxton, sp. n.
Furcula comparatively large (Gl960, fig. 64); aedeagus with ventral valves more exposed than above (Gl960, fig. 57);

(extreme southern California). *wilsoni* Gurney

9. Cercus more than twice as long as basal width, slender for group, clearly constricted basad of apical fourth, with both dorsal and ventral margins concave (G1960, figs. 43-45). 10
Cercus not as slender as preceding, constriction present or absent. 11
10. Cercus with ventral mesal hook near apex of each dorsal valve (G1960, fig. 38, *mh*); (northwestern California). *caroli* Gurney and Helfer
Cercus in lateral view with nearly straight ventral margin; aedeagus without mesal hook on each dorsal valve; (El Dorado County, California). *eremitus* Strohecker
11. Cercus with apex asymmetrical (G1960, fig. 29); aedeagus with right and left portions of fleshy main stem widely separated in posterior view, clearly exposing ventral valves (G1960, fig. 27); (Sonoma County, California). *olamentke* Hebard
Cercus with apex nearly symmetrical; aedeagus with right and left portions of main stem attingent or contiguous in posterior view, often concealing ventral valves12
12. Supra-anal plate with submedian longitudinal carinae strongly developed for more than half length of plate; dorsal valves of aedeagus conspicuous dorsad of main stem, a mesal lobe near apex of each valve prominent in posterior view; (Humboldt County, California). . . *hupah* Strohecker
Supra-anal plate with submedian longitudinal carinae weakly developed posterior to middle of plate; dorsal valves of aedeagus scarcely evident dorsad of main stem, no mesal lobe near apex of each valve; (Glenn County, California). *wintunus* Strohecker

Melanoplus ablutus Scudder

Melanoplus ablutus Scudder, 1899. Proc. Davenport Acad. Nat. Sci. 7: 185, pl. 8, fig. 3. (Type locality, by selection of Rehn and Hebard, 1912: Wawona, California), (Lectotype: Male, Museum of Comparative Zoology).
Subsequent references: Woodworth (1902: 19); Kirby (1910: 533); Rehn and Hebard (1910: 471; 1912: 89); Woodworth (1913: 311); Hebard (1935: 367); Gurney (1960: 148, figs. 1, 18-25, 54); Thompson and Buxton (1964: 39).
Distribution of material examined: CALIFORNIA: Yosemite National Park, Mariposa County.

Only a few specimens of *ablutus* have been reported. Scudder described it from 2 males and 9 females taken August 13 at Wawona, Mariposa County, by A. P. Morse. Rehn and Hebard (1910)

reported a single male taken at El Portal (entrance to Yosemite National Park), August 30, 2,050' elevation on a steep slope among dry leaves, manzanita and other bushes.

As indicated by the key, *ablutus* is best recognized by the cercus and aedeagus. The main stem of the aedeagus is fleshy and relatively short; the dorsal valves are moderately sclerotized and borne fairly well toward the base of the stem (each valve appears as a thin erect flap), broadly rounded apically; the ventral valves are small and broadly irregular at their apices.

Melanoplus caroli Gurney and Helfer

Melanoplus caroli Gurney and Helfer, *IN* Gurney, 1960. Proc. Entomol. Soc. Washington 62: 150, figs. 1, 38-50, 55. (Type locality, by original designation: Mendocino, Mendocino County, California), (Holotype: Male, United States National Museum).

Subsequent references: Helfer (1963: 257); Thompson and Buxton (1964: 39, 41).

Distribution of material examined: CALIFORNIA: Honeydew, Humboldt County; Willits, Rockport, Mendocino, Mendocino County.

The species is abundant near Mendocino, where Helfer and Gurney collected it September 23, 1964, on poor soil in the "pygmy forest" area of stunted trees and low shrubs. Helfer originally found it most plentiful in areas of scanty short grass exposed to full sun. Collecting dates for adults range from July 16 to October 15. Specimens from near the recorded habitat that agree with the key characters should be readily recognized.

Helfer (1963) referred to this as "Alexander's spur-throated grasshopper." The specific name is pronounced *cárolí*, having been based on Carolus, the Latinized form of the given name of Dr. Charles P. Alexander.

Melanoplus eremitus Strohecker

Melanoplus eremitus Strohecker, 1963. Pan-Pacific Entomol. 39: 162, figs. 4-6. (Type locality, by original designation: Top Lake, El Dorado County, California), (Holotype: Male, California Department of Agriculture).

Subsequent references: Thompson and Buxton (1964: 39, 42).

Distribution of material examined: CALIFORNIA: Top Lake, El Dorado County.

This species is known only from Top Lake, where it was taken August 22 and 27, associated with sedges (*Carex*). The elevation there is about 8,200'. Top Lake is located about 8 miles west of Fallen Leaf Lake (see Gurney and Buxton, Bull. Brooklyn Entomol. Soc. 58: 71, 1963).

MELANOPLUS GOEDENI Gurney and Buxton, sp. n.

(Figs. 100, 115-120)

HOLOTYPE MALE: Size medium for group.

Pronotum with median carina distinct, more appreciably noticeable on metazona. Tegmina separated and about three-fourths as long as pronotum. Median dorsal carina present on all abdominal segments.

Supra-anal plate (fig. 115) wider than long, sides sinuate, depressed; conspicuous transverse ridge present at termination of deep and broad longitudinal median trough; apical portion elevated, flattened; arms of furcula conspicuous, long, directed posterolaterally. Cercus (fig. 118) broad, symmetrical in apical portion, straplike, weakly constricted at midlength on dorsal margin only, apical third weakly inclined mesally.

Aedeagus (figs. 116, 117) bell-shaped in posterior view, dorsal valves high in comparison with ventral valves, ventral valves typical of *immunis* group; lophi (figs. 119, 120) moderately broad, sigmoid, bent sharply inward at base; ancora long, sharp, mesally curved.

Coloration with parallel lateral fastigial ridges black when viewed dorsally; head and metazona of pronotum brown with sparse black mottling, prozona of pronotum with heavy black mottling; tegmina a rich, deep brown; first three abdominal segments, including median carina, black; remaining abdominal segments tan to brown with dark mottling except for thin carina from segment 3 to apex which is tan; supra-anal plate tan except for dark brown central portion, apical half of cercus dark brown, basal half pale brown. Head laterally tan with dark brown area above antennal depression and behind eye; pronotum dark brown on prozona except for light brown band on lower fourth which extends over all of metazona. Labrum ventrally light tan with 3 black apical spots; maxillae light tan; remainder of venter rather uniform, dark tan. Hind femur with extero-lateral surface rich brown tinged with cherry on dorsal two-thirds, yellow on ventral third and ventrally, mesal surface pale, with four dark areas (at base, one-third way from base, just distad of midlength, and in genicular area). Hind tibia blue-green, spines dark brown to black, claws tan with dark brown tips; arolium light brown.

Measurements (in millimeters): Length of body, 17.7; pronotum, 4.5; hind femur, 10.3; front femur, 3.4; tegmen, 3.4. Greatest width of pronotum, 3.9; hind femur, 2.8; front femur, 1.1; tegmen, 2.3.

ALLOTYPE FEMALE: Same data as holotype. (United States Nat. Mus.). Robust in comparison to male. Median carina of pronotum broadly rounded, moving smoothly onto lateral lobes. Ovipositor valves robust, with dorsal "scoop" sharp, acutely angled; cercus robust, symmetrical, weakly convex dorsally and ventrally, scarcely longer than basal width. Coloration pale

in all areas in comparison with male; markings generally the same.

Measurements (in millimeters): Length of body, 20.1; pronotum, 5.6; hind femur, 12.1; front femur, 3.5; tegmen, 4.4. Greatest width of pronotum, 5.6; hind femur, 3.4; front femur, 1.0; tegmen, 3.3. (Abdomen is somewhat shortened and collapsed, so allotype may be partly teneral).

Specimens examined: OREGON: 1 male, 1 female, holotype, allotype. Holotype male: Summit of Siskiyou Mountains where Highway 99 crosses Siskiyou Range, Jackson County, Oregon, May 20, 1954, (John Davis), (United States Nat. Mus., Type No. 69,684).

The characters illustrated and used in the key distinguish this distinctive grasshopper. *M. goedeni* is readily separated from *kasadi*, the relative that is nearest geographically, by the male cercus.

It is a pleasure to name this grasshopper in honor of our friend Kenneth Goeden, Entomologist of the Oregon Department of Agriculture. Mr. Goeden has been particularly helpful in collecting and referring to us many interesting Orthoptera from Oregon.

MELANOPLUS HAIGI Gurney and Buxton, sp. n.

(Figs. 100-108)

HOLOTYPE MALE: Size medium for group.

Head in dorsal view with ratio of interocular distance to width of compound eye 5:14; fastigium moderately declivent, shallowly sulcate.

Pronotum with lateral carinae straight; median carina of prozona entire, not glossy, of metazona slightly raised and glossy; principal sulcus nearly straight; length ratio of median carina on prozona and metazona 21:16; posterior margin of metazonal disc evenly rounded, with trace of obtuse angulation at median carina; prosternal spine conical and projecting straight downward. Tegmina (fig. 101) reaching abdominal tergum 2, attingent at point midway of their length, length about three-fourths length of pronotum.

Abdomen with noticeable knob on apical portion.

Supra-anal plate (fig. 102) nearly equilaterally triangular, ratio of maximum width and length 15:14, apical third elevated and slightly ridged medially, lateral margins slightly sinuate and undulate, longitudinal submedian ridges strongly developed, attingent apically in a slightly rounded raised ridge. Furcula small, rounded apically, cylindrical, basally slightly bulbous; cercus (fig. 103) broadly attached, straplike, curving mesally at about 30° and barely directed dorsally, possessing moderately spatulate rounded apex.

Aedeagus (figs. 104, 105 prepared from paratype in glycerine) with dorsal valves long, tapering, projecting anteriorly and

dorsally, well dorsad of main stem; ventral valves showing striate structure and seemingly serrate margins (best seen in anterior view unless in posterior view with halves of main stem well separated), bluntly projecting anteriorly and mesally; main stem moderately sclerotized; apical membrane broadly attached and expanding slightly dorsally, almost reaching apex of dorsal valve. Epiphallus (fig. 8) has conspicuous widely separated ancorae and well developed anterior projections (ap); lophi (lo) heavy, broad, and well separated on the narrow bridge.

Coloration generally yellowish-orange to reddish-orange on dorsum of head, thorax, abdomen and legs; brown on sides of thorax, head, and abdomen; front and middle legs yellow-orange with black spines, claws black; arolium brown; hind femur reddish-orange dorsally, redder ventrally, medial area (including "chevrons") of lateral surface solid brown, darker toward apex, margined ventrally with pale stripe; hind tibia blue-green, spines and claws black, arolium brown.

Measurements (in millimeters): Length of body, 16.6; pronotum, 3.9; front femur, 3.0; middle femur, 3.4; hind femur, 9.4; tegmen, 3.1. Greatest width of pronotum (posterior, including lateral lobes in perspective from above), 3.0; front femur, 1.0; middle femur, 1.2; hind femur, 2.5; tegmen, 2.0.

ALLOTYPE FEMALE: Same data as holotype. (United States Nat. Mus.). Head in dorsal view with ratio of interocular distance to width of compound eye 7:15; compound eye less globose than in male; fastigium less declivent than male, barely sulcate; disk of pronotum much broader than male; tegmina separated by 0.9 mm; median carina of prozona and metazona with length ratio of 25:20; principal sulcus almost straight across median carina; cercus (fig. 106) with dorsal margin weakly concave, ventral margin straight, ratio of greatest width (basally, excluding dorsal tubercle) to length 4:6; dorsal valve of ovipositor (fig. 107) with well developed "scoop" and weak dorsal crenulation. Coloration essentially as in holotype, somewhat duller and darker.

Measurements (in millimeters): Length of body, 20.9; pronotum, 4.6; front femur, 3.0; middle femur, 3.9; hind femur, 11.0; tegmen, 4.3. Greatest width of pronotum, 4.3; front femur, 1.1; hind femur, 3.1; tegmen, 2.6.

Variation: Paratypes agree essentially with the holotype and allotype. Ten male and ten female paratypes have measurements (in millimeters) as follows: Length of body of males, 14.1-17.1, average, 15.3; of females, 18.7-22.9, average, 20.06; of pronotum of males, 3.5-3.9, average, 3.67; of females, 4.3-4.9, average, 4.6; hind femur of males, 8.2-9.0, average, 8.65; of females, 10.1-12.1, average, 11.02; of tegmen of males, 2.9-3.4, average, 3.12; of females, 3.6-4.7, average, 4.29.

Specimens examined: CALIFORNIA: Del Norte County: 45 males, 38 females, holotype, allotype, paratypes. Holotype male: 7 miles northeast of Smith River, Del Norte County, California, July 21, 1964, (T. R. Haig and J. Anderson). (California Department of Agriculture). Forty-three males, thirty-eight females,

7 miles northeast of Smith River, July 21, 1964, (T. R. Haig and J. Anderson), C.D.A.No. 64G27-4; 1 male, Pine Flat, Smith River, from meadowgrass, July 28, 1964, (L. Jensen), C.D.A.No. 64H10-31; 1 male, 17 miles northeast Smith River, 3,200' elevation, from pine mat, manzanita, dwarf juniper, August 18, 1964, (T. O. Peacock and L. Jensen), C.D.A.No. 64H20-4.

We believe that these collection data all refer basically to the same locality near Pine Flat Mountain, in Six Rivers National Forest. Mr. Jensen's data refer to 17 road miles ending at a point about 7 miles northeast of Smith River. Mr. Haig's notes state the area to be: "A little flat about four blocks square at about 3,000 feet; the grasshoppers were quite abundant and were confined to native grasses growing out of a serpentine soil. These were collected during a summer rain-storm." We name this species in honor of Mr. T.R. Haig.

M. haigi is most nearly related to *kasadi* and *goedeni* but is characterized by the aedeagus.

Melanoplus hupah Strohecker and Helfer

Melanoplus hupah Strohecker and Helfer, *IN* Strohecker, 1963.

Pan-Pacific Entomol. 39: 159, figs. 7, 8, 35. (Type locality, by original designation: Kneeland, Humboldt County, California), (Holotype: Male, United States National Museum).

Subsequent references: Thompson and Buxton (1964: 39, 43).

Distribution of material examined: CALIFORNIA: Kneeland, Humboldt County.

The only known distribution for *hupah* is the type locality, where, on July 11, 1960, near the Kneeland Post Office, the type series occurred "on damp, subirrigated land covered with lush grass and white clover. The grasshoppers were definitely associated with the clover."

Male genital organs are distinctive for *hupah*.

Melanoplus immunis Scudder

Melanoplus immunis Scudder, 1899. Proc. Davenport Acad. Nat.

Sci. 7: 167, 170. (Type locality, by original designation: Mary's Peak, Benton County, Oregon), (Lectotype, designated by Rehn and Hebard (1912): Male, Museum of Comparative Zoology).

Melanoplus usitatus Scudder, 1899. Proc. Davenport Acad. Nat.

Sci. 7: 168, 172. (Type locality, by original designation: Corvallis, Benton County, Oregon), (Lectotype, designated by Rehn and Hebard (1912): Male, A. P. Morse Collection, now at Museum of Comparative Zoology). Synonymy first published by Fulton (1930) who stated that Hebard had written to him to that effect.

Subsequent references: Kirby (1910: 532); Rehn and Hebard (1912: 88); Hebard (1920: 379-380); Fulton (1930: 618); Gurney

(1960: 147, figs. 1-6); Helfer (1963: 256).

Distribution of material examined: OREGON: Harrisburg (Diamond Hill section), Linn County; Corvallis, Mary's Peak, Benton County.

Fulton (1930) said that *immunis* was common on Mary's Peak and on Jackson's Hill near Corvallis, and also that it probably was confined to isolated hilltop prairies. Helfer (1963) reported its occurrence on Mary's Peak in a large grassy meadow with *M. saltator*. Dates on adult specimens seen by us range from July 23 to August 19.

MELANOPLUS KASADI Gurney and Buxton, sp. n.

(Figs. 100, 109-114)

HOLOTYPE MALE: Size average for group.

Pronotum with median carina barely distinct on prozona, less so between sulci, evident (but low) on metazona. Tegmina lobate, three-fourths as long as pronotum.

Supra-anal plate (fig. 109) with furcula of medium size for group and rounded, longitudinal trough shallow, apparent only on basal two-thirds, lacking transverse ridge, apical one-third elevated. *Cercus* (fig. 112) with asymmetrical, apical portion curved moderately mesally, bluntly angled at apex about 45°.

Aedeagus (figs. 110-111) broad with dorsal valves thin, well distad of and higher than rather broad ventral valves. *Lophi* (fig. 113) well developed dorsally, truncate; *ancorae* (an) moderately long, pointed, well separated on bridge.

Coloration with dorsum darkly mottled in deep brown on pronotum, less mottled and somewhat lighter on abdomen. Head behind eye and lateral lobe of pronotum reddish-brown; interocular area dark mottled brown, front light brown, clypeus light tan; metanotum medium brown; abdomen black laterally. All ventral parts uniformly tan. Hind femur medium brown, darker toward apex except for four dark brown patches on mesal face, one at base, another small area one-third way from base, another large area just distad of midlength, the fourth in genicular area carrying around to extero-lateral surface.

Measurements (in millimeters): Length of body, 17.8; pronotum, 4.1; hind femur, 9.6; front femur, 3.5; tegmen, 3.3. Greatest width of pronotum (posteriorly, including lateral lobes in perspective from above), 3.4; hind femur, 2.6; front femur, 1.1; tegmen, 2.0.

Specimens examined: OREGON: Jackson County: 1 male (holotype). Holotype male: Wrangle Gap, Rogue River National Forest, Jackson County, Oregon, 6,800' elevation, August 11, 1950, (C. P. Alexander), (United States Nat. Mus., Type No. 69,683).

The type locality, Wrangle Gap, is apparently 6,496' elevation, (on the topographic map, Talent quadrangle), about 3 miles north of the California line and about 12 miles southwest of Ashland, Oregon. Dr. Alexander stated in a letter (October 27,

1961) that he believed the habitat was among alder thickets along a mountain stream at an elevation of 6,500' to 6,800'.

This species is closely related to *Melanoplus rehni*, *M. goedeni*, and *M. haigi*, but the aedeagus of each is diagnostic.

The name is modified from Kahosadi, a small group that comprised a division of Shasta Indians found in the vicinity of the type locality.

Melanoplus lovetti Fulton

Melanoplus lovetti Fulton, 1930. Ann. Entomol. Soc. America 23: 615, fig. 1, A-E. (Type locality, by original designation: Woodruff Meadows, Jackson County, Oregon), (Holotype: Male, United States National Museum).

Subsequent references: Gurney (1960: 148, figs. 1, 12-17, 56).

Distribution of material examined: OREGON: Woodruff Meadows, Jackson County.

Fulton described *lovetti* from a series of 14 males and 5 females, all from Woodruff Meadows, and we know of no additional specimens. The specimens were collected August 5, 1922 from an area covered by moss and short grass, for the most part, and shaded much of the day by a nearby forest. The aedeagus and cercus of *lovetti* are diagnostic.

Melanoplus olamentke Hebard

Melanoplus olamentke Hebard, 1920. Trans. American Entomol. Soc. 46: 391, pl. 17, fig. 11. (Type locality, by original designation: southern Sonoma County, California), (Holotype: Male, Academy of Natural Sciences of Philadelphia).

Subsequent references: Hebard (1935: 363, pl. 24, figs. 1, 2); Gurney (1960: 150, figs. 1, 26-32); Thompson and Buxton (1964: 39, 44).

Distribution of material examined: CALIFORNIA: Trinit, Sonoma County; county label only (paratype).

No ecological data accompanied Hebard's original description. The holotype and single paratype were collected December 4, 1910. The Trinit specimen was collected December 20, 1937 by N. W. Frazier. In 1935 Hebard referred *olamentke* to the "Lepidus Group", but the pattern of aedeagal structures, especially the position of the ventral valves and the lack of a membranous marginal expansion along the dorsal valve (both characteristic of the *immunis* group), distinguishes *olamentke* from *lepidus* and the latter's allies.

Melanoplus rehni Hebard

Melanoplus rehni Hebard, 1920. Trans. American Entomol. Soc. 46: 379, pl. 16, fig. 8, pl. 17, fig. 5. (Type locality, by original designation: Glendale, Douglas County, Oregon), (Holotype: Male, Academy of Natural Sciences of Philadelphia).

Subsequent references: Gurney (1960: 147, figs. 1, 7-11).

Distribution of material examined: OREGON: Glendale, Douglas County.

Hebard's original series consisted of 16 males and 13 females, and were from Siskiyou, Jackson County, Oregon, August 13, in addition to the type locality, August 12. At Glendale, he reported *rehni* as scarce and "very active in small openings among the heavy growth of tall firs, in a valley of the Rogue River Mountains (1,500-1,900' elevation)."; at Siskiyou "on the steep forested slopes of the Siskiyou Mountains, it was found scarce in the forest undergrowth from 4200 to 5600 feet... others in the alpine undergrowth of a forest of scattered pine and alpine hemlock, where an interdigitating flora of the Canadian and Hudsonian Zones occurred."

Melanoplus wilsoni Gurney

Melanoplus wilsoni Gurney, 1960. Proc. Entomol. Soc. Washington 62: 158, figs. 1, 53, 57-64. (Type locality, by original designation: Lyons Peak?, San Diego County, California), (Holotype: Male, United States National Museum).

Subsequent references: Thompson and Buxton (1964: 39, 45).

Distribution of material examined: CALIFORNIA: "Lyonshill" (Presumed to be Lyons Peak; discussed in detail in G1960), San Diego County.

The only specimens of *wilsoni* are the holotype and allotype, collected May 16, 1940, and labeled as swept from grass. The supra-anal plate and furcula are especially distinctive, supplementing the cercus and aedeagus as important features. The swollen middle femur of the female also is notable.

Melanoplus wintunus Strohecker and Helfer

Melanoplus wintunus Strohecker and Helfer, IN Strohecker, 1963. Pan-Pacific Entomol. 39: 160, figs. 9, 10, 34. (Type locality, by original designation: Plaskett Meadows, Glenn County, California), (Holotype: Male, California Department of Agriculture).

Subsequent references: Thompson and Buxton (1964: 39, 46).

Distribution of material examined: CALIFORNIA: Plaskett Meadows, Glenn County.

The type locality is an extensive area of high range country.

Sixteen males and nine females were collected there with the holotype on July 26, 1961 (J. R. Helfer); one male was taken there August 22, 1952 (F. L. Blanc) also.

THE *HARPERI* SPECIES-GROUP OF *MELANOPLUS*

Melanoplus harperi, the only member of this group, was based on 34 specimens collected in 1963. During September 10-15, 1964, at Grizzly Meadows, California, Buxton, Gurney, and Richard M. Thompson collected 47 specimens (35 males, 12 females) living among grasses and herbaceous weeds in a mountain meadow and at the margins of woodland on dry slopes. These specimens vary sufficiently from the type series to merit comment. We have also examined a male of typical *harperi* taken June 23, 1931 at Big Flat by E. C. Van Dyke (A.N.S.P.). Differences noted are as follows:

1. In typical *harperi*, the aedeagus bears a conspicuous sclerotized lateral piece (fig. 33, slp). In the variant population from Grizzly Meadows, the basic structure occurs, as shown by dissections, but the apex is scarcely developed (fig. 34). So far as shown by the extracted aedeagi of 7 paratypes and the Coffee Creek male in comparison with 13 males of the variant, this character is a constant difference.

2. The hind femur of typical *harperi* is yellow to light yellow from the lower carinula of the external surface over the lower marginal area and onto the inner medial area. There is a faint trace of pink rarely on the external surface below the carinula. In the variant population, these areas are almost always reddish orange (about 7A6 of the 1962 Reinhold Color Atlas). Although the color intensity varies somewhat, only 2 or 3 of the Grizzly Meadows specimens could be confused with typical *harperi* in this regard.

The lophi of the epiphallus sometimes extend dorsally more than in typical *harperi*, but this feature is variable. At first we thought there was an average difference in the two populations with respect to width of male cerci. However, variation occurs within the variant population (extremes are shown in figs. 35 and 36), and we are unable to use the cercus as a character for separating the two populations at the specific level. Likewise, it seemed during early comparisons that the hook of the dorsal valve of the aedeagus (figs. 33, 34, h) is less sharply acute and more inclined to have a double apex in the variant than in typical *harperi*. Numerous dissections indicate, however, that consistent differences are lacking and that a double apex is sometimes created by the separation of layers of sclerotized material comprising the hook.

Melanoplus harperi Gurney and Buxton

Melanoplus harperi Gurney and Buxton, 1965. Occasional Papers Bur. Entomol., California Department of Agriculture 7: 4, figs. 6-8, 11, 12, 18-23, 26, 29, 30. (Type locality, by original designation: East Weaver Lake, Trinity County, California), (Holotype: Male, California Department of Agriculture, Sacramento, California).

Distribution of material examined: CALIFORNIA: Big Flat (Coffee Creek), Grizzly Meadows, East Weaver Lake, Trinity County.

Grizzly Meadows is about 7 miles west and slightly south of Big Flat and about 18 miles north of East Weaver Lake. At about 6,500' elevation, Grizzly Meadows is a little higher than the two localities from which typical *harperi* is presently recorded.

We conclude that the variation does not justify nominal recognition though a tendency toward subspeciation may exist. Samples from a larger number of localities might further clarify the situation.

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EXPLANATION OF FIGURES

Figs. 1-4, Divided plates of sclerite of dorsal fold, male genital complex.

1. *Karokia blanci* Rehn, from Grizzly Meadows, California.
2. *K. memorialis*, paratype.
3. *Boonacris glacialis glacialis* (Scudd.), from Mt. Mansfield, Vermont.
4. *Boonacris polita* (Scudd.), from Tombstone Prairie, Linn County, Oregon.

Figs. 5-8, Supra-anal plate, male.

5. *K. memorialis*, paratype.
6. *K. blanci*, Grizzly Meadows, California.
7. *Boonacris alticola* Rehn and Randell, from Mary's Peak, Oregon.
8. *Hebardacris mono* Rehn, paratype.

9. *Nisquallia olympica* Rehn, female paratype from Mt. Ellinor, Mason County, Washington. Lateral view of ventral valve of ovipositor.
10. *Boonacris alticola* Rehn and Randell, female from Mary's Peak, Oregon. Lateral view of apex of abdomen.
11. *K. blanci* Rehn, female from Grizzly Meadows, California. Lateral view of apex of abdomen.

Figs. 12-13, Ventral view of apex of abdomen, female.

12. *K. blanci*, Grizzly Lake, California.
13. *K. memorialis*, paratype.

Figs. 14-16, Dorsal view of apex of abdomen, female.

14. *K. memorialis*, paratype.
15. *K. blanci*, from Grizzly Meadows, California.
16. *Boonacris alticola*, from Mary's Peak, Oregon.

Figs. 17-21, Left cercus, male.

17. *K. blanci* Rehn, from Grizzly Meadows, California.
18. *K. memorialis*, holotype.
19. *Buckellacris nuda nuda* (E. M. Walker), from Banff, Alberta.
20. *Buckellacris chilcotinae chilcotinae* (Hebard), from Chilcotin, British Columbia.
21. *Boonacris alticola* Rehn and Randell, from Mary's Peak, Oregon.

Figs. 22-23, Left cercus, female.

22. *K. blanci*, Grizzly Lake, California.
23. *K. memorialis*, paratype.
24. *Bradynotes obesa opima* Scudder, male, from Mt. Shasta, California. Dorsal view of pronotum.
25. *Nisquallia olympica* Rehn, female paratype from Mt. Ellinor, Washington. Lateral view of head and anterior margin of pronotum.

Figs. 26-29, Dorsal view of epiphallus, male.

26. *Buckellaeris nuda nuda* (E. M. Walker), from Banff, Alberta.
27. *K. blanci* Rehn, from Grizzly Meadows, California.
28. *K. memorialis*, paratype.
29. *Boonacris alticola* Rehn and Randell, from Mary's Peak, Oregon.
30. *K. memorialis*, male paratype. Anterior margin of epiphallus.

Figs. 31-32, Lateral view of epiphallus, male.

31. *K. memorialis*, holotype.
32. *K. blanci*, from Grizzly Meadows, California.

Figs. 33-34, Dorso-posterior view of aedeagus, right half only.

33. *Melanoplus harperi* Gurney and Buxton, paratype.
34. *M. harperi*, from Grizzly Meadows, California.

Figs. 35-36, Left cercus, male.

35. *M. harperi*, from Grizzly Meadows, California.
36. *M. harperi*, another male from Grizzly Meadows, California.
37. *Boonacris alticola* Rehn and Randell, from Mary's Peak, Oregon. Lateral view of aedeagus.
38. *K. blanci* Rehn, from Grizzly Meadows, California.
39. *K. memorialis*, paratype.

Figs. 40-41, Posterior view of aedeagus.

40. *K. memorialis*, paratype.
41. *K. blanci*, from Grizzly Meadows.
42. Map showing distribution of species of *saltator* group of *Melanoplus*, based on specimens examined.

Figs. 43-50, Left cercus, lateral view.

43. *M. buxtoni* Strohecker, from Seven Troughs, Plaskett Meadows, Glenn County, California.
44. *M. elaphrus* Strohecker, from 3 miles east of Blue Lake, Humboldt County, California.
45. *M. elater* Strohecker, paratype from 5 miles northeast Zenia, Trinity County, California.
46. *M. ascensus* Scudder, lectotype from Mt. Shasta, California.
47. *M. siskiyou* Strohecker, from Mt. Eddy, California.
48. *M. ostentus*, paratype, 17 miles northeast Smith River, California.
49. *M. validus* Scudder, paralectotype, Grant's Pass, Oregon.
50. *M. calapooyae* Hebard, paralectotype, Divide, Oregon.

Figs. 51-58, Supra-anal plate, male, same specimens as in figs. 43-50.

51. *M. elater* 52. *validus* 53. *M. ostentus* 54. *siskiyou*
55. *M. buxtoni* 56. *M. ascensus* 57. *M. elaphrus*
58. *M. calapooyae*.

Figs. 59-69, Lateral view of aedeagus, showing rami of the cingulum (membrane dorsad of ramus indicated by stippling).

59. *M. buxtoni*, same specimen as in fig. 43.
60. *M. lepidus*, paratype from Truckee, California.
61. *M. elater*, paratype, same as in fig. 45.
62. *M. bernardinae*, paratype from Vivian Creek, California.
63. *M. elaphrus*, same as in fig. 44.
64. *M. siskiyou*, same as in fig. 47.
65. *M. saltator*, paratype from Portland, Oregon.

- 66. *M. ostentus*, paratype, same as in fig. 48.
- 67. *M. ascensus*, lectotype.
- 68. *M. calapooyae*, same as in fig. 50.
- 69. *M. validus*, same as in fig. 49.

Figs. 70-80, Posterior view of aedeagus, showing rami of cingulum (membrane dorsad of ramus indicated by stipling).
Same specimens as in figs. 59-69.

- 70. *M. burtoni* 71. *lepidus* 72. *elater* 73. *bernardinae*
- 74. *elaphrus* 75. *siskiyou* 76. *saltator* 77. *ostentus*
- 78. *ascensus* 79. *calapooyae* 80. *validus*.

Figs. 81-90, Sclerite of the dorsal fold, KOH preparation,
same specimens as in figs. 59-69.

- 81. *M. ascensus* 82. *elater* 83. *burtoni* 84. *ostentus*
- 85. *lepidus* 86. *calapooyae* 87. *siskiyou* 88. *validus*
- 89. *saltator* 90. *elaphrus*.

Figs. 91-99, Dorsal view of epiphallus, same specimens as in
figs. 59-69.

- 91. *M. ostentus* 92. *elaphrus* 93. *saltator*
- 94. *siskiyou* 95. *validus* 96. *calapooyae* 97. *ascensus*
- 98. *elater* 99. *burtoni*.

- 100. Distribution map, species of *immunis* group of
Melanoplus, based on specimens examined.

Figs. 101-108, *Melanoplus haigi*, drawn from paratypes.

- 101. Habitus, lateral view.
- 102. Dorsal view, male supra-anal plate, cerci and subgenital plate.
- 103. Apical portion of abdomen, lateral view of right side.
- 104. Aedeagus, posterior view.
- 105. Aedeagus, lateral view of right side.

106. Left cercus of female.

107. Dorsal valve of ovipositor, left lateral view.

108. Dorsal view of epiphallus.

Figs. 109-114, *Melanoplus kasadi*, drawn from holotype.

109. Supra-anal plate, dorsal view.

110. Aedeagus lateral view of right side.

111. Aedeagus, posterior view.

112. Left cercus.

113. Epiphallus, dorsal view.

114. Epiphallus, lateral view from left side.

Figs. 115-120, *Melanoplus goedeni*, drawn from holotype.

115. Supra-anal plate, dorsal view.

116. Aedeagus, lateral view of right side.

117. Aedeagus posterior view.

118. Left cercus.

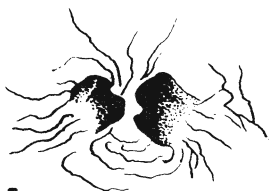
119. Epiphallus, dorsal view.

120. Epiphallus, lateral view from left side.

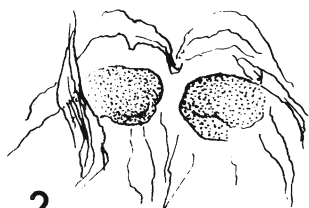
EXPLANATION OF ABBREVIATIONS

(Terms in quotation marks are not proposed as formal morphological terms but rather are used as general terms for convenience to assist readers in locating structures which are discussed).

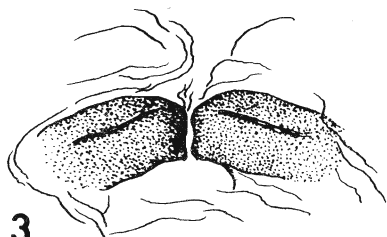
an	ancora
ap	anterior projection of epiphallus
bt	basal tooth of ventral valve of ovipositor
de	"depression" at anterior end of distal ridge of supra-anal plate
dv	dorsal valve of aedeagus
fc	furcula (comprising 2 arms)
h	"hook" of dorsal valve of aedeagus
kn	"knob" on ramus of cingulum
la	"lateral arm" of dorsal valve of aedeagus
lfc	lateral facial carina
lle	"lobelike expansion" of main stem of aedeagus
lo	lophus
lp	"lateral prominence" of supra-anal plate
ms	"main stem" of aedeagus
ppdv	"posterior portion" of dorsal valve of aedeagus
ra	ramus of cingulum
slc	sinuate carina near base of supra-anal plate
slp	"sclerotized lateral piece" of aedeagus
tl	"triangular lobe" of dorsal valve of aedeagus
vv	ventral valve of aedeagus



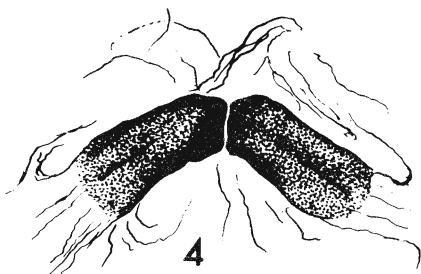
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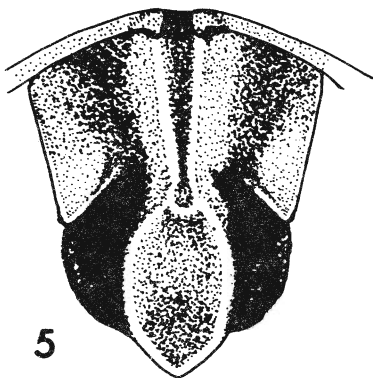
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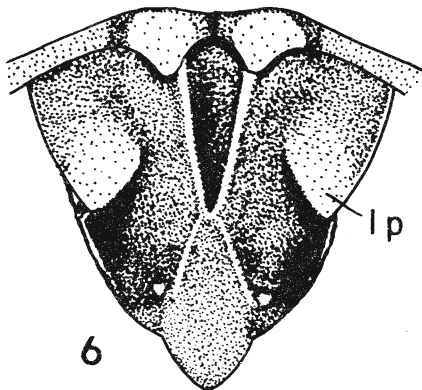
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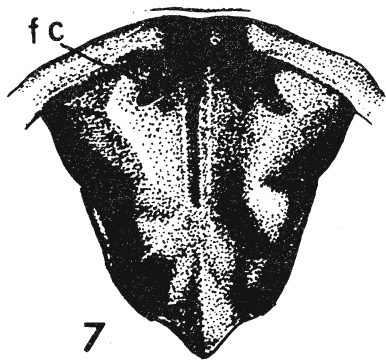
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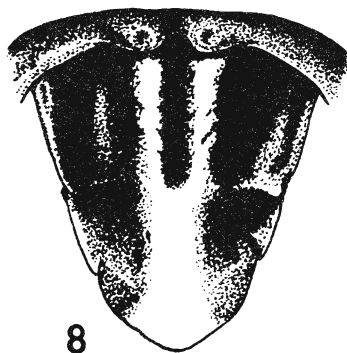
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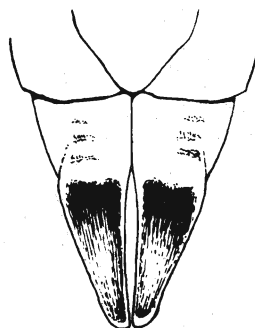
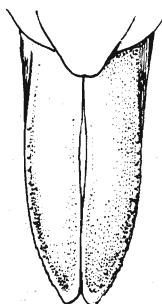
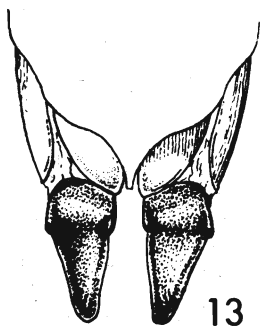
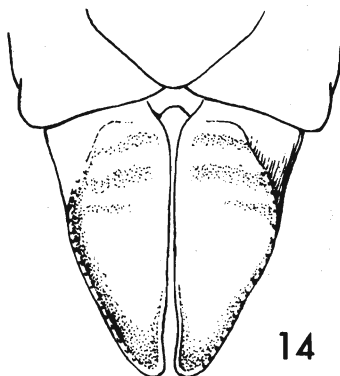
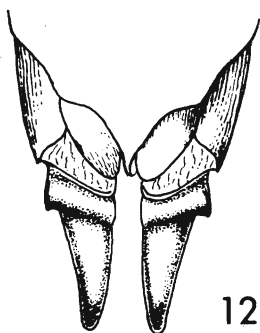
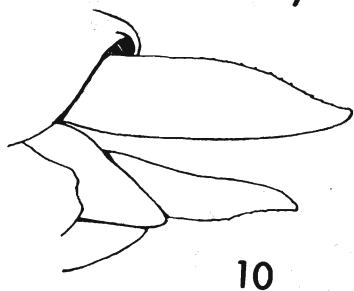
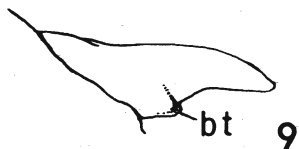
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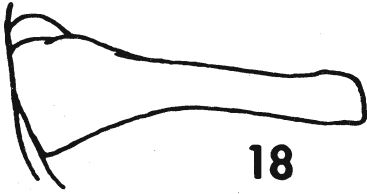


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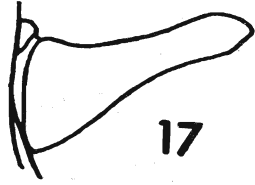


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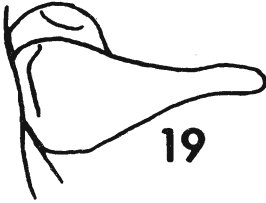




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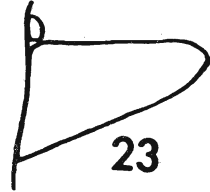
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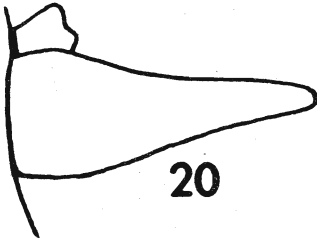
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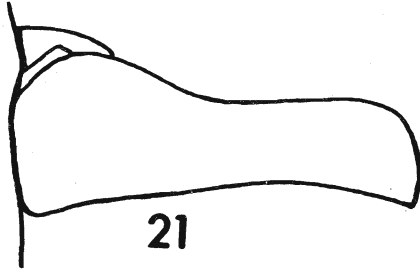
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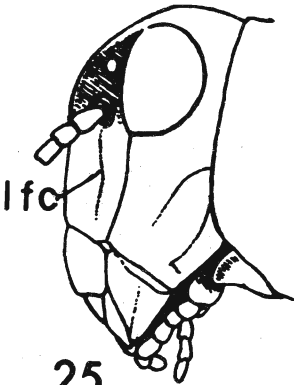
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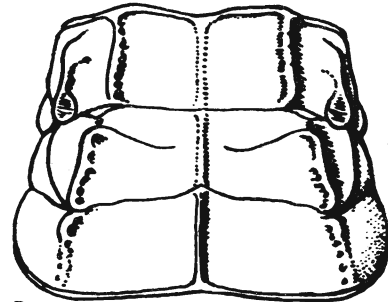
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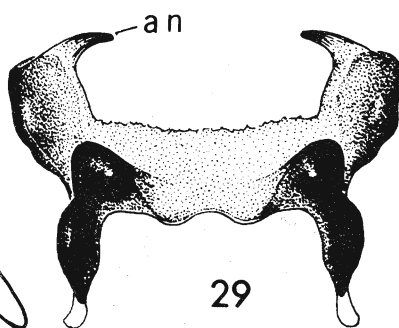
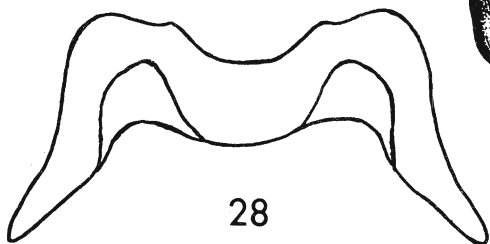
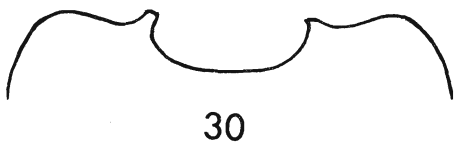
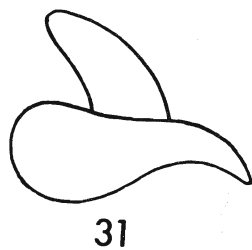
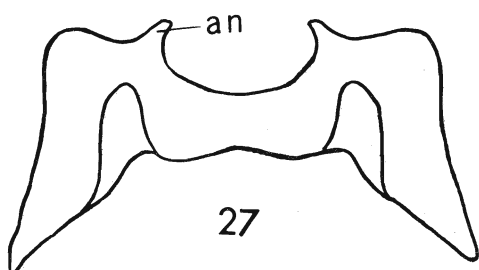
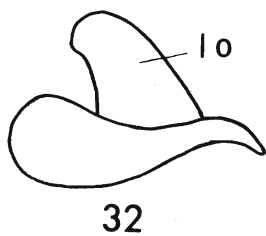
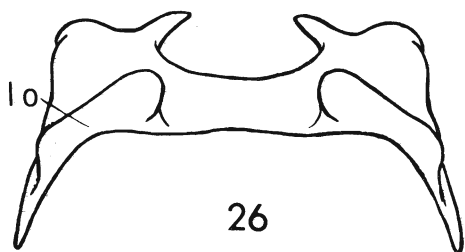
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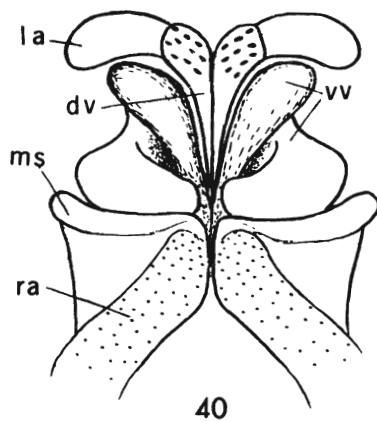
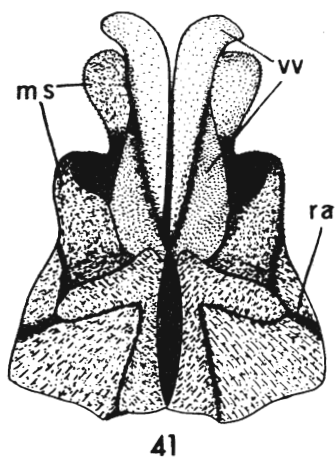
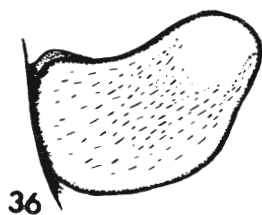
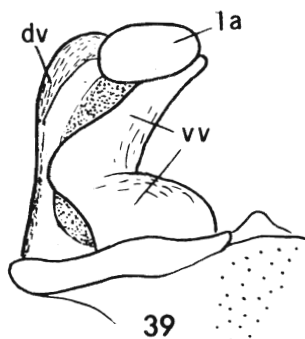
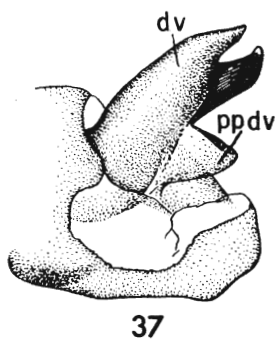
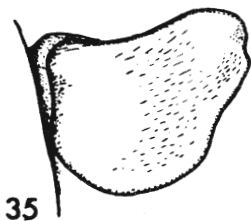
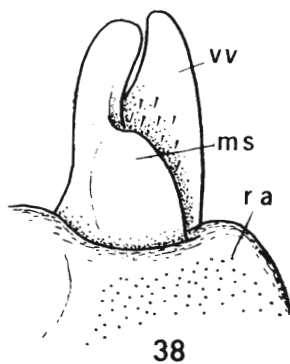
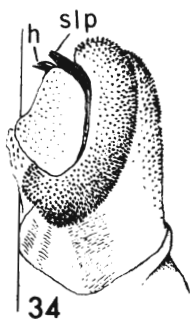


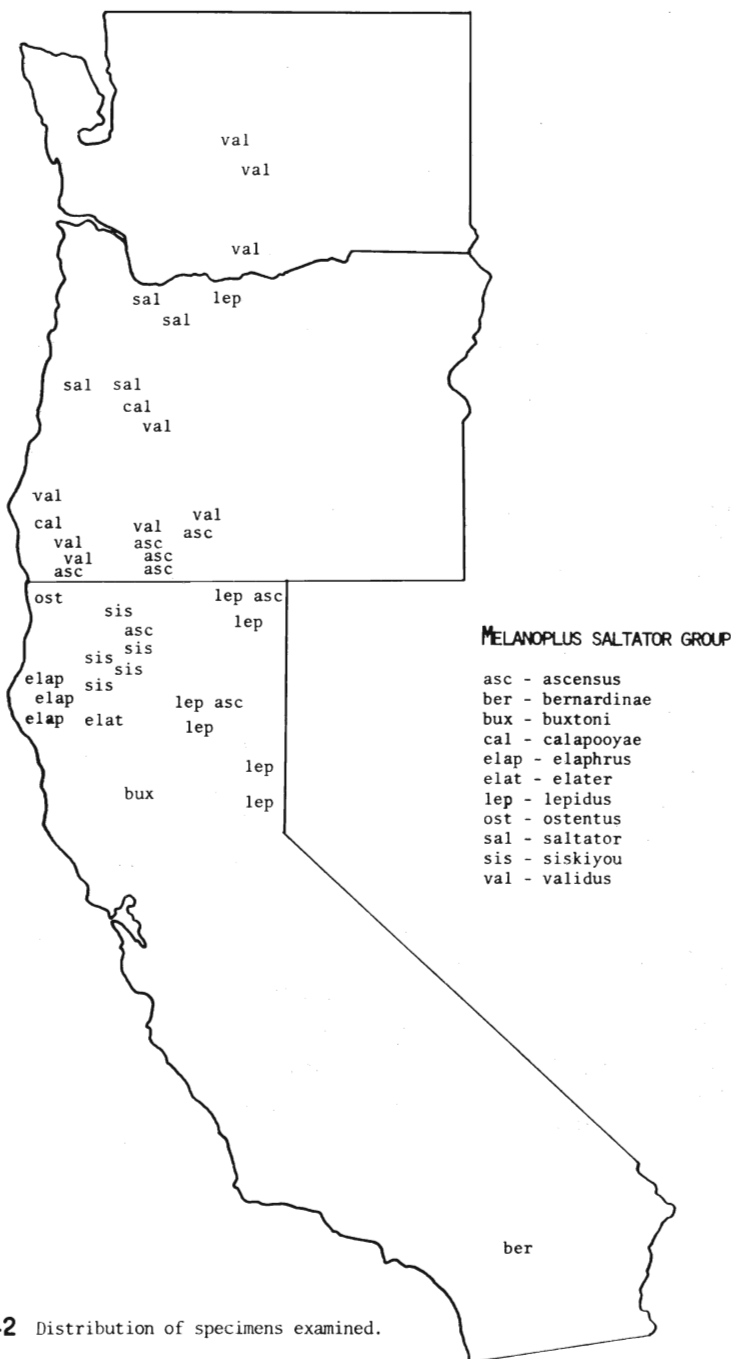
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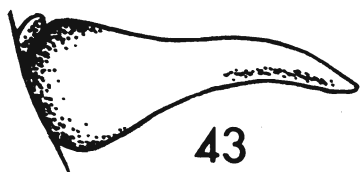


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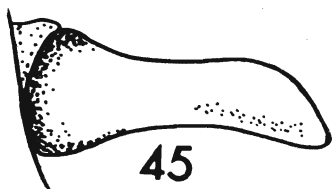




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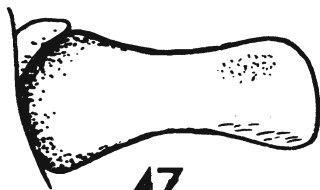
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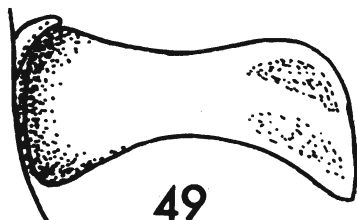
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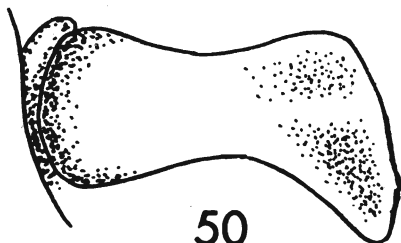
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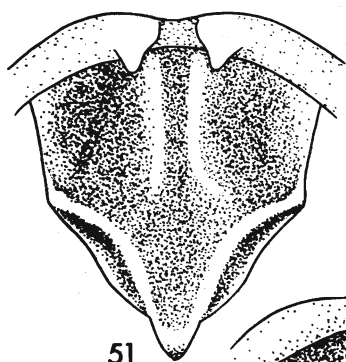
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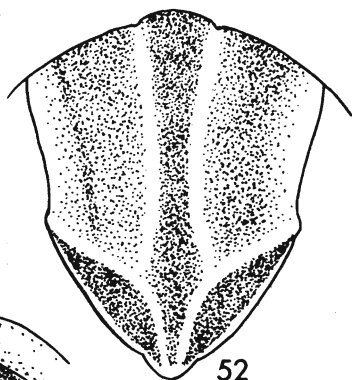
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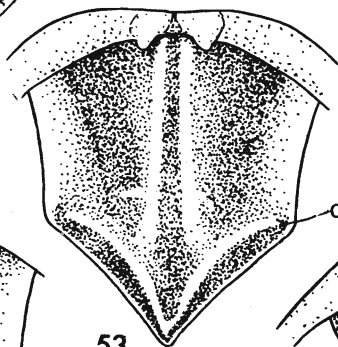
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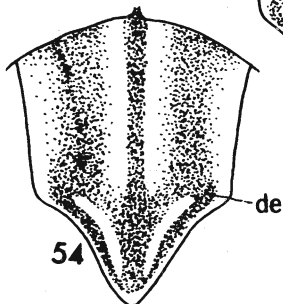
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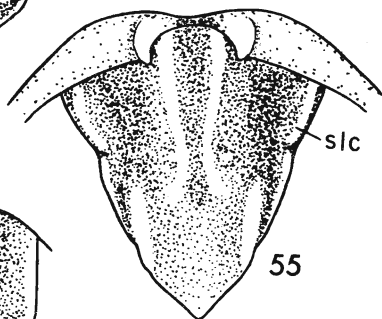
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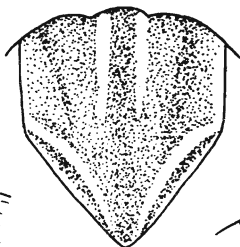
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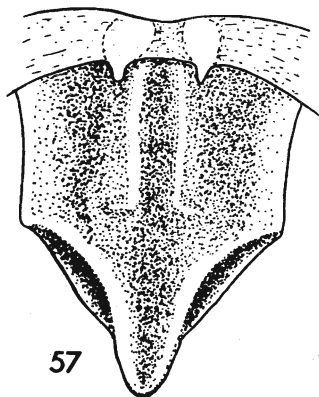
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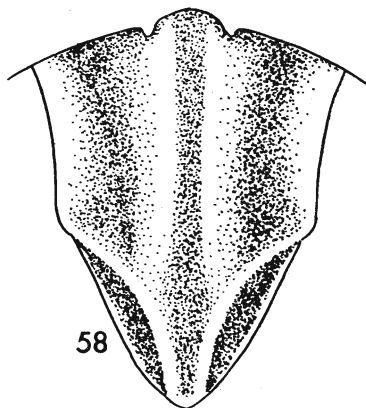
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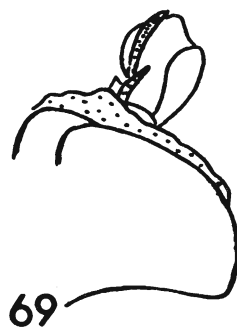
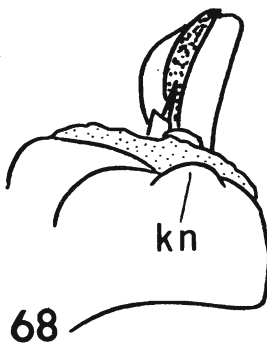
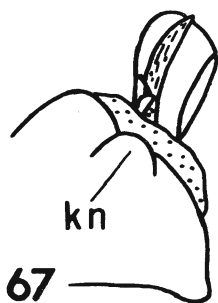
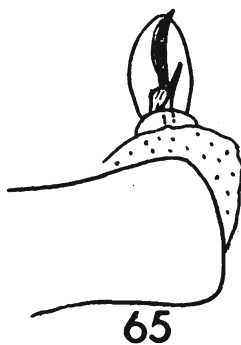
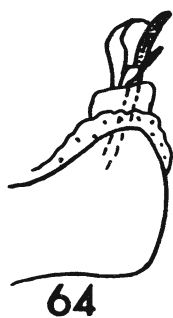
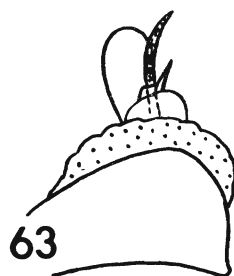
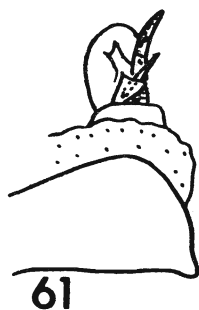
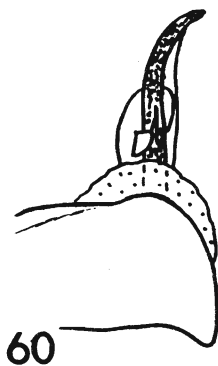
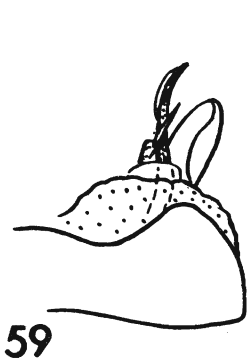
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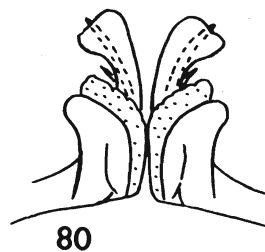
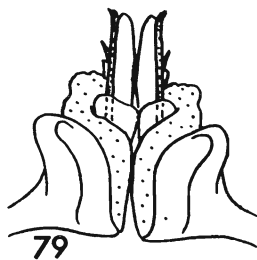
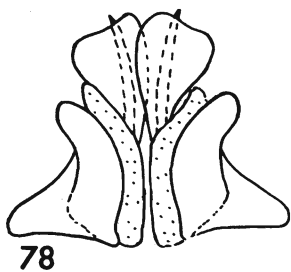
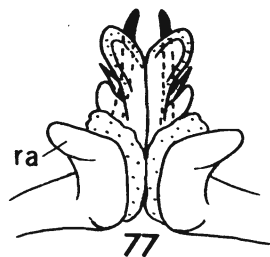
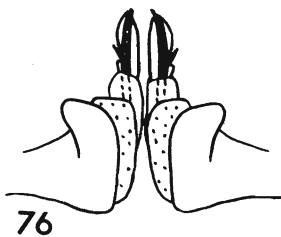
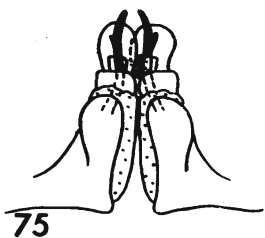
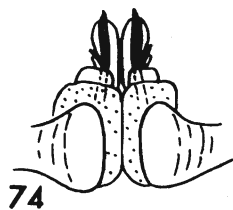
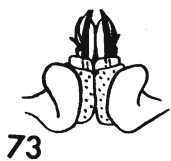
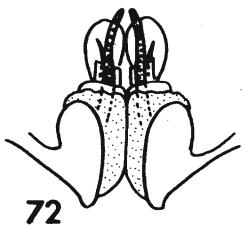
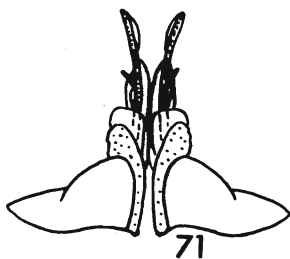
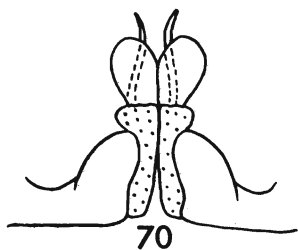


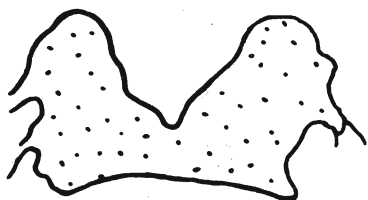
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58



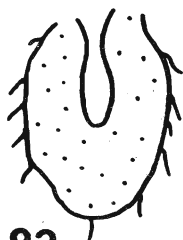




81



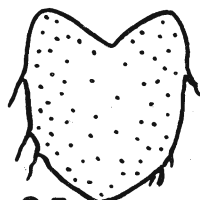
82



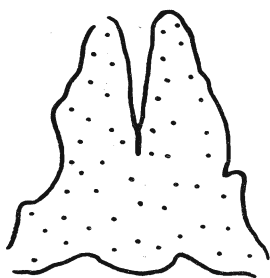
83



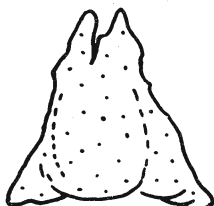
84



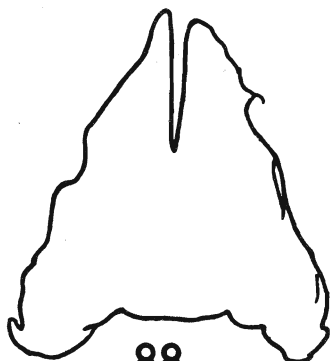
85



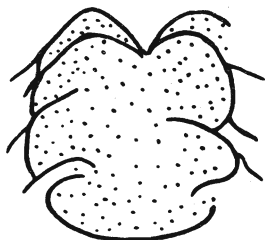
86



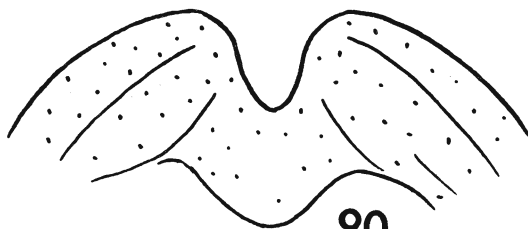
87



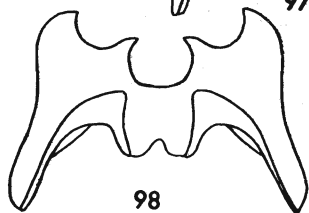
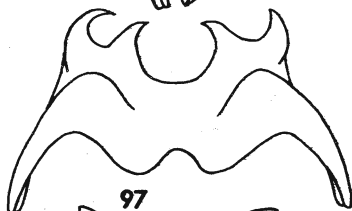
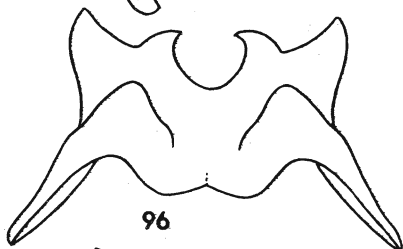
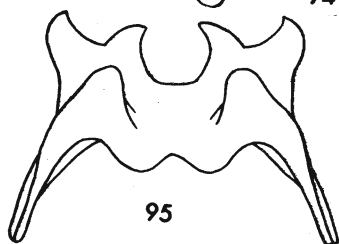
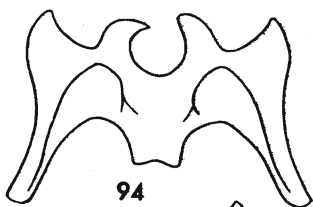
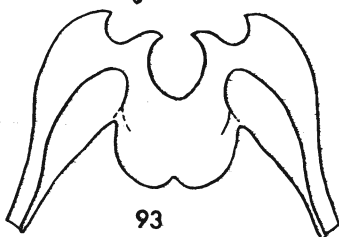
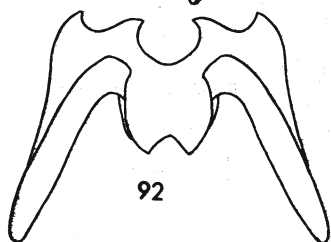
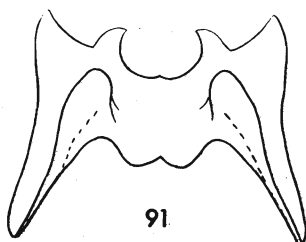
88

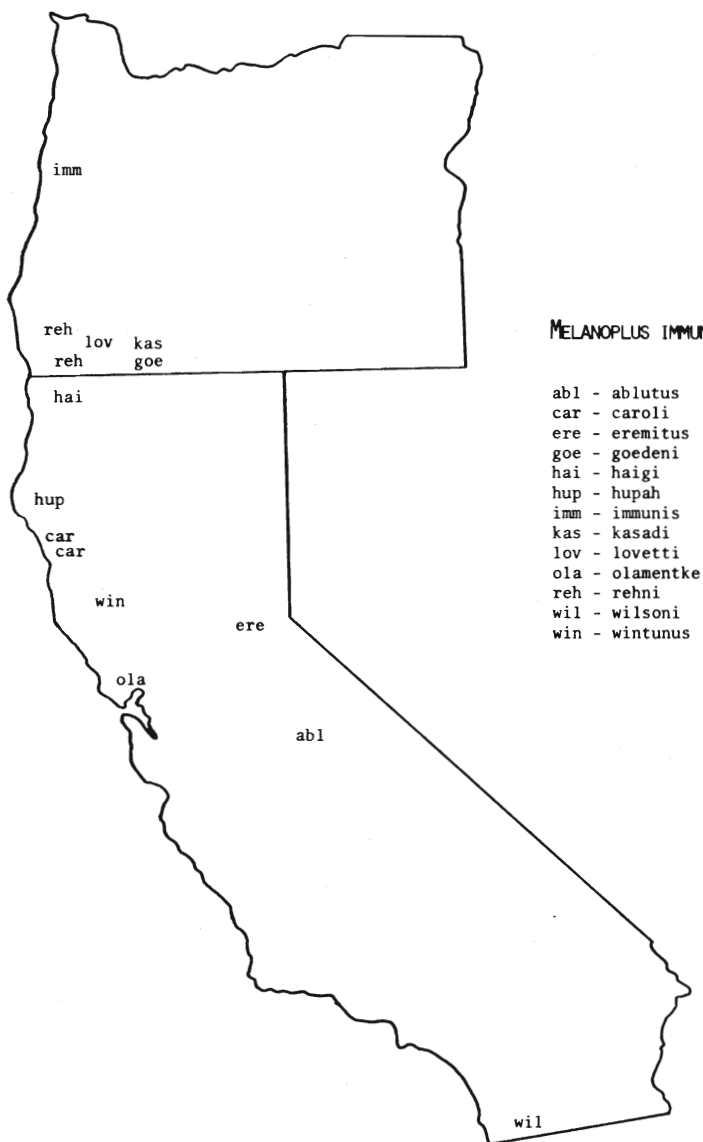


89

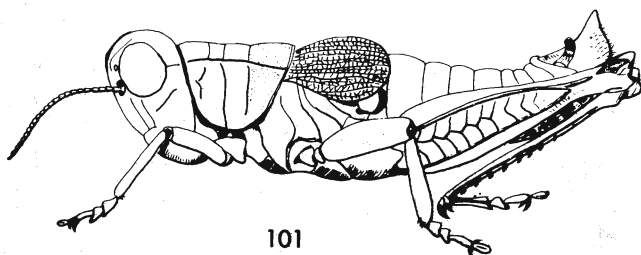


90





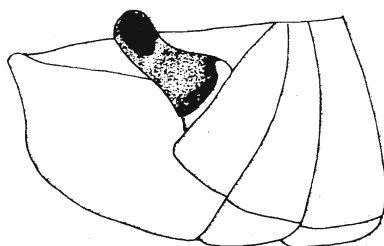
100 Distribution of specimens examined.



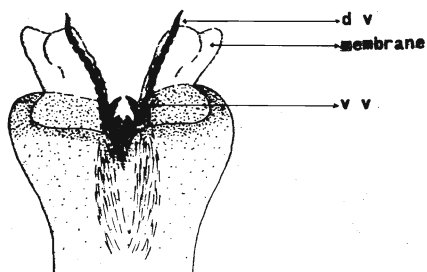
101



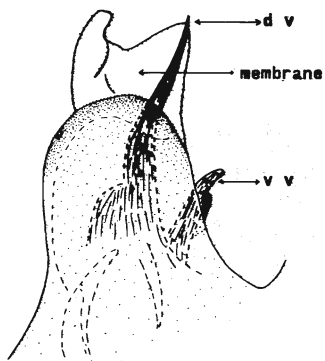
102



103



104



105



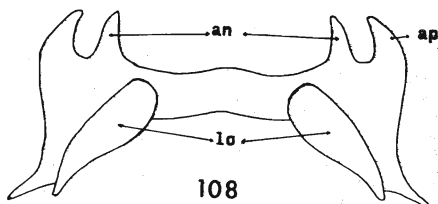
♀ cercus

106



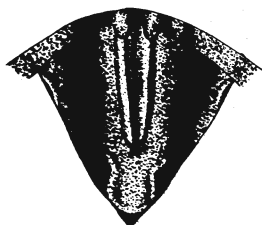
ovipositor

107

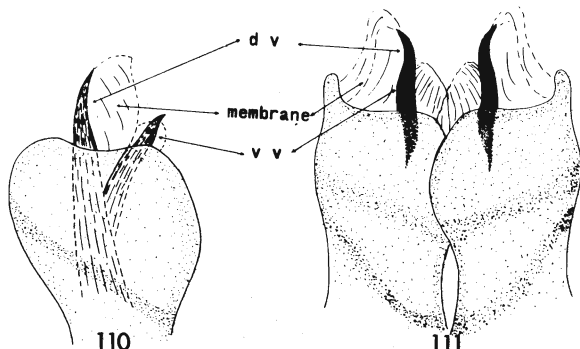


108

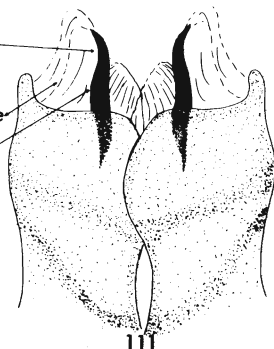
haigi



109



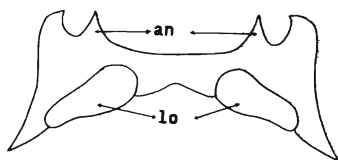
110



111



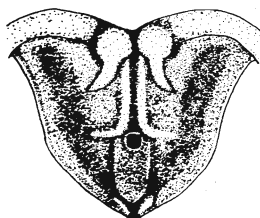
112



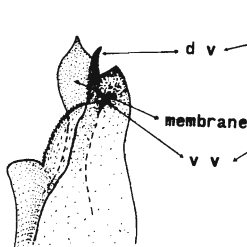
113
kasadi



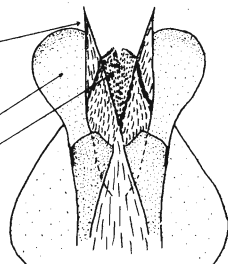
114



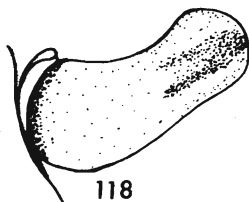
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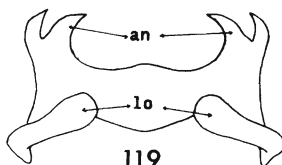
116



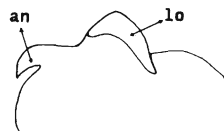
117



118



119
goedeni



120